

# Exploring Potential Impacts of Weatherization and Healthy Homes Interventions on Asthma-related Medicaid Claims and Costs in a Small Cohort in Washington State



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Environmental Sciences Division

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Interventions on Asthma-related Medicaid Claims and Costs in a Small  
Cohort in Washington State**

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September 2015

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# CONTENTS

CONTENTS.....	iii
LIST OF FIGURES .....	v
LIST OF TABLES .....	vii
ACRONYMS AND ABBREVIATIONS .....	ix
ACKNOWLEDGEMENTS .....	xi
EXECUTIVE SUMMARY .....	xiii
1. INTRODUCTION .....	1
2. INDOOR ENVIRONMENTAL QUALITY AND CHILDREN WITH ASTHMA.....	3
2.1 ASTHMA AND WEATHERIZATION .....	6
2.2 OVERVIEW OF ASTHMA MORBIDITY IN WASHINGTON STATE .....	11
3. WEATHERIZATION PLUS HEALTH .....	13
4. STUDY DESCRIPTION .....	15
4.1 METHODOLOGY .....	15
4.1.1 Research Design.....	16
4.1.2 Limitations .....	17
4.2 DATA COLLECTION .....	17
4.2.1 Participant Inclusion and Recruitment.....	17
4.2.2 Home Visits .....	19
4.2.3 Database Development .....	20
4.2.4 HCA Medicaid Records Collection .....	20
4.2.5 Data Transfer to ORNL analysts.....	21
4.2.6 Data Collection Challenges.....	21
5. DESCRIPTIVE STATISTICS FROM THE STUDY SAMPLE.....	23
5.1 CHARACTERIZATION OF STUDY PARTICIPANTS AND HOUSING UNITS .....	23
5.2 PRESENCE OF HOME-SOURCE EVIDENCE-BASED ASTHMA TRIGGERS .....	25
5.2.1 Moisture and Mold.....	29
5.2.2 Chemicals and Cleaning Supplies.....	30
5.3 ALLERGY REDUCTION MEASURES.....	31
5.3.1 Ventilation.....	32
5.4 IMPACTS OF WEATHERIZATION AND HEALTHY HOMES EDUCATION .....	34
5.5 WEATHERIZATION AND HEALTHY HOMES MEASURES INSTALLED .....	36
5.5.1 Indoor Temperatures .....	38
5.6 OCCUPANT HEALTH AND HEALTH CARE COVERAGE .....	39
6. ANALYSIS OF MEDICAID RECORDS .....	45
6.1 CHARACTERIZATION OF MEDICAID STUDY DATA AND PARTICIPANTS .....	45
6.2 IMPACT ANALYSIS.....	49
7. CONCLUSION.....	55
REFERENCES .....	57
APPENDIX A. DATA FORMS AND SURVEY INSTRUMENTS COLLECTED DURING INTERVENTION .....	A-1
A.1 INFORMED CONSENT FORM FOR WEATHERIZATION PLUS HEALTH STUDY .....	A-1
A.2. HOUSING UNIT INFORMATION SURVEY – DF2 .....	A-5
A.3. ASTHMA HOME ENVIRONMENT CHECKLIST (EPA).....	A-21
A.4. ASTHMA CONTROL TEST FOR CHILDREN AGE 4 TO 11 YEARS .....	A-28
A.5. HEALTHY HOMES ACTION PLAN .....	A-29
A.6. SATISFACTION SURVEY .....	A-30
A.7. POLLUTION SOURCE SURVEY.....	A-33

APPENDIX B. SURVEY INSTRUMENTS (COLLECTED OVER COURSE OF STUDY) ..... B-3  
    B.1. OCCUPANT SURVEY ..... B-3  
    B.2. WALK THROUGH CHECKLIST (WEATHERIZATION PLUS HEALTH) ..... B-22  
APPENDIX C. WASHINGTON STATE INSTITUTIONAL REVIEW BOARD APPLICATION ..... C-3

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
Figure 2.1. List of Evidence-Based Environmental Asthma Triggers .....	4
Figure 2.2. Frequency of WAP Measures Installed in Homes in PY 2008.....	7
Figure 3.1 List of Opportunity Council Asthma Trigger Reduction Measures .....	13
Figure 5.1: Weatherization and Healthy Homes Measures Installed by Group: Weatherization Plus Health and Weatherization Only .....	38
Figure 6.1. Graphic of Average Claims and Costs per Month for All Study Groups Pre- and Post- Intervention.....	52





## LIST OF TABLES

Table	Page
Table 4.1. Average (Mean) Number of Months Between Program Delivery and Post-Intervention Data Collection.....	18
Table 5.1. Age Ranges of Children with Asthma in Study Households – by Program Type .....	24
Table 5.2. Household Ethnicity and Race – All Groups Combined .....	24
Table 5.3. Housing Type/Characteristics – by Group.....	25
Table 5.4. Residence Status of Household – by Group.....	25
Table 5.5. Location of Household -All Groups Combined .....	25
Table 5.6. Home-Source Evidence-Based Asthma Triggers Pre and Post-Intervention by all Groups' .....	28
Table 5.7. Moisture Issues Pre and Post-Intervention by all Groups .....	30
Table 5.8. Chemicals and Cleaning Supplies Post-Intervention by all Groups .....	31
Table 5.9. Number of Homes that Received Full or Simple Healthy Homes Packages, Per Program Type.....	31
Table 5.10. Presence of Asthma Trigger Reduction Measures Post-Intervention by all Groups.....	32
Table 5.11. Potential Sources of Indoor Environmental Contaminants Post-Intervention by all Groups .....	33
Table 5.12. Presence of Functional and in Use Mechanical Ventilation Measures Post-Intervention .....	34
Table 5.13. Natural Ventilation Post-Intervention by all Groups .....	34
Table 5.14. Comparison of Use of Chemical Cleaning Supplies Pre to Post-Intervention by All Groups .....	35
Table 5.15. Frequency of Changing/Cleaning Furnace Filter Post-Intervention by All Groups .....	35
Table 5.16. Frequency of Dusting/Cleaning and Vacuuming Post-Intervention by All Groups .....	36
Table 5.17. Weatherization Measures Installed In Moderate Climate Region for National Sample .....	37
Table 5.18. House Air Leakage Rate Pre and Post-Intervention by Group: .....	38
Weatherization Plus Health and Weatherization Only (mean CFMs) .....	38
Table 5.19. Indoor Temperatures Pre and Post-Intervention by All Groups .....	39
Table 5.20. Health care Coverage Post-Intervention - All Groups .....	39
Table 5.21. Health Status (Head of Household) Post-Intervention - All Groups*.....	41
Table 5.22. Health Status (Child) Post-Intervention - All Groups*.....	42
Table 5.23. Other Health Issues (Child) Post-Intervention - All Groups.....	43
Table 6.1. Medicaid Data Collected by Research Group.....	46
Table 6.2. Percent of Healthy Homes Cases That Received Either Full Or Simple Packages .....	46
Table 6.3. Caregiver-Reported Demographics and Housing Characteristics by Study Group .....	47
Table 6.4. ICD-9 Codes Listed As Primary Diagnosis for Line Claims .....	48
Table 6.5. Header and Line Claim Types .....	49
Table 6.6. Header and Line Claim Types by Research Group.....	49
Table 6.7. Super-utilizer Status by Research Group.....	49
Table 6.8. Results from a Paired Sample T-Test Comparing Difference of Means between the Average Number of Claims Submitted Per Month Pre- and Post-Intervention by Research Group .....	51
Table 6.9. Results from a Paired Sample T-Test Comparing Difference of Means between Average Costs per Claim Submitted Pre- And Post-Intervention by Research Group.....	51



## ACRONYMS AND ABBREVIATIONS

AHS	American Housing Survey
ARRA	American Recovery and Reinvestment Act of 2009
CA	Cost analysis
CAA	Community Action Agency
CBA	Cost-benefit analysis
CDC	U.S. Centers for Disease Control and Prevention
CEA	Cost-effectiveness analysis
CFM	Cubic feet per minute
CHW	Community Health Worker
CMCS	Center for Medicaid and CHIP Services
COI	Cost of illness
CUA	Cost-utility analysis
DDT	Dichlorodiphenyltrichloroethane
DOE	U.S. Department of Energy
ECM	Energy cost measure
ED	Emergency department
EPA	Environmental Protection Agency
ERMI	Environmental Relative Moldiness Index
ETS	Environmental tobacco smoke
FTE	Full time equivalent
FTP	File transfer protocol
GAO	Government Accountability Office
GHG	Greenhouse Gas
HCA	Health Care Authority
HCUP	Health Care Utilization Project
HEPA	High Efficiency Particulate Air
HH	Healthy Homes
HHS	U.S. Department of Health and Human Services
HIPPA	Health Insurance Portability and Accountability Act of 1996
HUD	U.S. Housing and Urban Development
HVAC	Heating, ventilation and air conditioning
IEA	International Energy Agency
IEQ	Indoor Environmental Quality
IOM	Institute of Medicine
IRB	Institutional Review Board
MEPS	Medical Expenditure Panel Survey
NACP	National Asthma Control Program
NCEH	National Center for Environmental Health
NIEHS	National Institute of Environmental Health Sciences
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung and Blood Institute
NO <sub>2</sub>	Nitrogen dioxide
NPR	National Public Radio
NRC	National Research Council
OC	Opportunity Council
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory

OWIP	Office of Weatherization and Intergovernmental Programs
PI	Principal Investigator
PII	Personally Identifiable Information
PM	Particulate matter
POCs	Persistent organic compounds
PV	Present value
PY	Program Year
QALY	Quality adjusted life year
QoL	Quality of life
RCT	Randomized Controlled Trial
SES	Socioeconomic status
SF	Single family
SFT	Secure File Transport
SNA	Social Network Analysis
SVOCs	Semi-volatile organic compounds
SPSS	Statistical Package for the Social Sciences
WAP	Weatherization Assistance Program
WBH	Washington Basic Health
WHO	World Health Organization
WSIRB	Washington State Institutional Review Board
Wx	Weatherization

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## EXECUTIVE SUMMARY

This report presents results from an analysis of the asthma-related health impacts of weatherization and healthy homes interventions using data collected from 49 households in Northwestern Washington State covering the period from 2006 to 2013. This study was performed as part of a broader evaluation of the U.S. Department of Energy’s Weatherization Assistance Program (WAP) that Oak Ridge National Laboratory (ORNL) conducted for the Department of Energy (DOE).

Healthy housing intervention programs aim to improve health outcomes for occupants through improvements in dwelling quality. Households of low socioeconomic status (SES) are more likely to reside in homes with structural damage, elevated levels of lead, indoor allergens, radon, environmental contaminants, and other dwelling quality issues known to have pathogenic effects on health (Krieger et al. 2002, 2010; Matte et al. 2000). ORNL and the Opportunity Council,<sup>1</sup> a Community Action Agency (CAA) in Northwestern Washington State, partnered to collect and analyze caregiver-reported, field-collected, and health care records data to discern potential asthma-related benefits of these programs in the areas of improved dwelling quality, caregiver observed asthma morbidity, and direct health care utilization and costs. The study enrolled Medicaid-insured Healthy Homes Only, Weatherization Plus Health, and WAP Only participants with caregiver-reported asthma diagnoses to monetize the impacts of program interventions on health care costs. The above-mentioned groups will be referred to as such in the remainder of this report.

Comparing pre- and post-intervention data for the three study groups revealed that both weatherization (e.g., air sealing, insulation, heating equipment installation and maintenance) and healthy housing interventions (e.g., flooring replacement, ventilation, dust mite mattress and pillow covers, education) were impactful with respect to improving dwelling quality and reducing home-source asthma triggers. These data suggest benefits accrue through the delivery of WAP in concert with the Healthy Homes intervention, which is expected since those programs fund the provision of different, but complimentary, services. Observations of improved dwelling quality, health, and wellbeing (e.g., decrease in moisture and mold issues, improved thermal comfort) were made. Caregiver-reported information revealed child health improvement, in general, post-intervention. All households within the Healthy Homes groups and 82% of the WAP Only group reported that children “seemed to feel better.” All households within the Weatherization Plus Health group, 94% of the Healthy Homes Only group, and 64% of the Weatherization Only group reported children in their care “could run and play longer” post-intervention. These results begin to substantiate the claim that both weatherization and healthy housing interventions improve dwelling quality with the potential for synergistic benefits of WAP plus healthy housing evident.

The data indicate that Medicaid-insured study participants residing in homes that received either Weatherization Plus Health, Healthy Homes, or standard WAP services experienced statistically significant decreases in health care utilization and costs post-intervention. Specifically, a statistically significant decrease of \$421 was observed in annualized asthma-related Medicaid costs for all study groups combined. The average number of claims paid by the Washington State Medicaid program also decreased significantly within the Weatherization Plus Health and WAP Only groups by 0.42 and 0.91 claims per month, respectively. It is possible that the Healthy Homes Only sample in this study, which included participants with higher baseline amounts of claims and costs per month overall, would have benefited from the additional measures provided through Weatherization Plus Health and WAP.

The public health community has given recent attention to “super-utilizers” of the U.S. health care system to help alleviate health disparities and reduce costs that disproportionately burden households of low SES and communities of color. The Center for Medicaid and CHIP Services (CMCS 2013) defines super-

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<sup>1</sup> <http://www.opcco.org/>

utilizers as “beneficiaries of complex, unaddressed health issues and a history of frequent encounters with health care providers.” Based on the findings of this study, it is reasonable to propose that the Opportunity Council and other healthy housing programs give high priority to families that have children with severe asthma and to members of populations or demographics disproportionately burdened with asthma (e.g., American Indians in Washington State), to maximize the potential impact of these programs.

This study explored the potential for assessing programmatic impacts using data on outcome measures contained in linkable Medicaid files and physician records. We conclude that it is possible to collect and link these data at individual and household levels.

The data collected through this study suggest that Weatherization Plus Health, Healthy Homes, and WAP all contribute to a reduction in asthma-related health effects, but additional research is required to better attribute the observed reductions in Medicaid claims and costs to these programs and to generalize the results to all program recipients. Promising savings were observed across all study groups, but sample sizes in some instances were too small to achieve statistical significance.

Overall, the services delivered by the participating agencies in this study were associated with significantly reduced health care costs for Medicaid-insured children with asthma residing in Northwestern Washington State. Evaluations of asthma intervention programs are often befogged by numerous confounding factors (e.g., demographics, geographic location, severity of illness, exposure to environmental triggers) and the difficulty of quantifying improved health outcomes (e.g., reduced psychosocial stress, productivity gains, educational attainment) (Corso and Fertig 2009; Smith et al. 1997). Although a large body of evidence has amassed over the past several decades suggesting causality and associations between poor Indoor Environmental Quality (IEQ) and health, many experts in the public health and housing domains recommend further research to study the relationships between specific housing intervention measures, indoor exposure to contaminants, and disparities and health outcomes for better understanding of the determinants of these exposures, as well as, impacts attributable to WAP specifically (Breyse et al. 2004; Breyse et al. 2014; Wu and Takaro 2007). Further investigation of the cumulative exposure to indoor contaminants, known to have pathogenic effects on health, contributes to a better understanding of indoor environmental justice issues and improves the efficacy of programs charged with creating parity for groups burdened by adverse health outcomes related to poor IEQ.



## 1. INTRODUCTION

This report is part of the Recovery Act period national evaluation of the U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP). The evaluation is being managed by Oak Ridge National Laboratory (ORNL) on behalf of DOE. The pages that follow present findings from one of several components of the WAP evaluation, an exploratory analysis of the impacts of weatherization and healthy home interventions on asthma-related health care utilization and costs. This study provided an opportunity to assess the potential impact of WAP and additional asthma trigger reduction measures on direct and indirect outcomes for a small cohort of children burdened with asthma in Northwestern Washington State.

WAP was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the Program as currently stated in the Code of Federal Regulations (CFR) 10 CFR 440.1 is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." (Code of Federal Regulations, 2011)

WAP provides grants, guidance, and other support to Grantees: weatherization programs administered by each of the 50 states, the District of Columbia, territories and several Native American tribes. The Grantees, in turn, oversee a network of 900+ local community action agencies, nonprofit organizations, and local government agencies that are eligible to receive weatherization funding from DOE (subgrantees). These subgrantees qualify income-eligible households, assess their homes' energy efficiency opportunities, install energy-saving measures, and inspect each home post-weatherization. Common weatherization measures include: air sealing, wall and attic insulation, duct sealing, furnace repair and replacement, as well as home improvements needed to ensure the health and safety of household occupants. The work is done at no cost to the eligible participants.

The Opportunity Council, a Community Action Agency (CAA) located in Northwestern Washington State, has operated a Weatherization Plus Health program since 2000; originally funded as a U.S. Department of Housing and Urban Development (HUD) Healthy Homes demonstration project.<sup>2</sup> The Opportunity Council's Healthy Homes program works to reduce asthma triggers inside the homes of families with young children. The services provide a range of tailored measures from the provision of simple products (e.g., dust mite covers for mattresses and pillows, High Efficiency Particulate Air (HEPA) vacuum cleaners, and non-toxic cleaning kits) to interventions requiring contracted work (e.g. replacement of carpet with laminate or hard wood flooring and/or the installation of whole house ventilation systems.) This Opportunity Council program is delivered as either a stand-alone service, known as the Healthy Homes program, or in concert with WAP, the Weatherization Plus Health program. The hypothesis put forth by the research team, comprised of both Opportunity Council and ORNL staff, posits that the Weatherization Plus Health and Healthy Homes programs impact asthma morbidity among the population served and that these changes are observable in the health care data. Similar to other multi-attribute asthma trigger reduction programs targeting the home environment, it was believed these impacts could be directly observed in relatable and linkable health care records and insurance claims. This study enrolled Medicaid-insured Healthy Homes, Weatherization Plus Health, and WAP only participants with caregiver-reported asthma diagnosis to discern potential benefits of these programs in the areas of improved dwelling quality, caregiver observed asthma morbidity, and direct health care utilization and costs. Any relationships observed from these data contribute to the body of literature and research efforts

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<sup>2</sup> Retrieved from: [http://portal.hud.gov/hudportal/HUD?src=/program\\_offices/healthy\\_homes/hhi/hhd](http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/hhi/hhd)

investigating the efficacy of home-based multi-attribute programs charged with reducing environmental exposure to asthma triggers, thereby improving health outcomes.

Section 2.0 of this report contains a discussion of the research related to indoor environmental quality (IEQ) and children with asthma followed by an overview of the Weatherization Plus Health and Healthy Homes programs delivered through the Opportunity Council (Section 3.0). Section 4.0 provides the study description complete with methodology and data collection employed to capture program impacts on health care utilization and costs. Section 5.0 provides descriptive statistics to characterize study participants and households, and section 6.0 discusses program impacts and other insights gleaned from the research. Lastly, section 7.0 contains conclusions based on the data and existing body of research relevant to the topics discussed. Appendices A and B contain pre- and post-intervention survey and data collection instruments administered, respectively. Appendix C contains the approved version of the study's Washington State Institutional Review Board (WSIRB) application.

## 2. INDOOR ENVIRONMENTAL QUALITY AND CHILDREN WITH ASTHMA

Understanding the asthma-related health benefits of weatherization and healthy homes interventions is of utmost importance as asthma continues to be one of the most common chronic pediatric diseases and the leading cause of school absences and pediatric hospitalizations disproportionately impacting children in poverty, children of Hispanic and African American ethnicity, communities of color, and those residing in urban environments (Akinbami et al. 2011; Breysse et al. 2004; Breysse et al. 2014; Bryant-Stephens 2009; Castro 2003; U.S. Centers for Disease Control and Prevention (CDC) 2011; Corso and Fertig 2009; Dixon et al. 2008; EPA 2013; Kattan et al. 1997; Kreiger et al. 2005, 2010; NIH 2011; NHIS 2011; Rastogi et al. 2013; Sullivan et al. 2002; Wu et al. 2007). Trends in asthma over the past few decades suggest a constant increase in asthma prevalence across demographics with additional burden on children, and communities of color and low SES (Akinbami et al. 2011, 2012). Although asthma cannot be cured, it can be controlled through medical treatment and by addressing other factors contributing to poor asthma control in children (e.g., environmental factors) (Corso and Fertig 2009; McGhan et al. 2006). Because approximately 80% of all persistent asthma cases present before age six, the indirect lifetime burden and costs (e.g., loss of productivity, interference with childhood development) of asthma have the potential to exceed the direct costs (e.g., health care) (Corso and Fertig 2009; Martinez 2002).

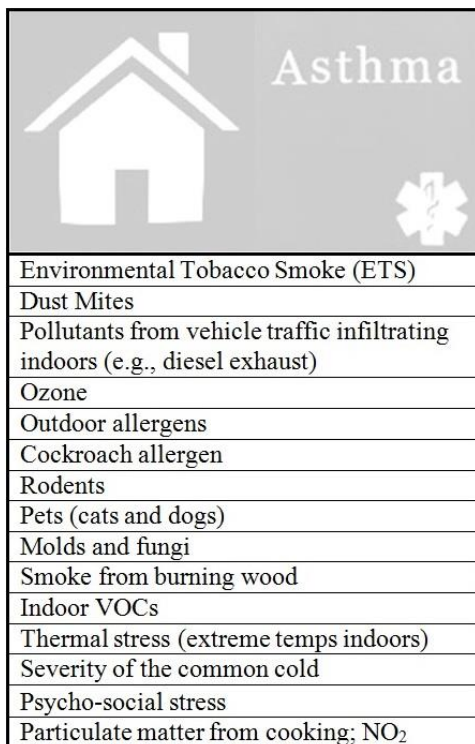
Asthma continues to be one of the most chronic and costly diseases in the U.S. with nearly 26 million Americans suffering its effects (9.5% of all children) and an annual cost of \$56 billion (EPA 2013). Nearly two million ED visits and 500,000 hospitalizations each year provide the bulk of the direct costs of asthma. It is one of the leading causes of school absences with more than half of children with asthma missing school due to symptoms for a total of more than 13 million missed days a year (CDC 2013). Households of low SES are three times more likely to reside in homes with structural damages, elevated levels of lead, indoor allergens, radon, environmental contaminants, and other dwelling quality issues known to have pathogenic effects on health (Evans and Kantrowitz 2002; Krieger et al. 2002; Matte et al. 2000). Families that live in these homes are at-risk for exposure to multiple environmental health and safety hazards placing the most vulnerable occupants at significantly greater risk for illnesses and injuries. The body of research examined in this section provides evidence that the effects of environmental health and safety hazards in homes contribute billions of dollars (CDC 2011) annually to both the health and economic burdens in society while placing households of low SES at a greater disadvantage. Mitigating exposure to indoor and outdoor source contaminants and hazards through healthy housing interventions contributes to on-going efforts to reduce chronic disease outcomes for households disproportionately burdened by their effects (Breysse et al. 2004; Breysse et al. 2014; Crocker et al. 2011; Dixon et al. 2008; Evans 1999; Kattan et al. 2005; Kreiger et al. 2005 & 2010; Takaro et al. 2011; Wilson et al. 2014; Woodfine et al. 2011; Woods et al. 2012; Wu and Takaro 2007).



Social justice in the context of human health is generally equated with access to health resources and equal opportunity to a healthy life. Determinants for domestic health disparities (health outcomes that impact certain populations to a greater extent than others) have been identified and integrated into social programs tasked with combatting chronic disease in the U.S. (Healthy People 2020, 2014). The research described herein targets two of the factors identified as contributors to health disparities; social determinants and environmental exposures to contaminants. To increase recognition and inform strategies addressing health disparities in the U.S., assessments and identification of place-based drivers of indoor pollutants and effective remediation measures are on-going. Environmental justice involves differential income, racial and ethnic or other types of vulnerable population exposure to environmental health risks (Evans and Kantrowitz 2002). Evans and Kantrowitz (2002) state that exposure to indoor environmental risks is not randomly distributed among the general population in the U.S. and that housing quality is inversely correlated to income. Children of low SES households and communities of color are exposed to

greater amounts of environmental toxins than those of moderate to high SES (Evans and Kantrowitz 2002).

There is a considerable body of evidence suggesting that exposure to these environmental risks occurs indoors along with claims that these exposures are inextricably linked to adverse and chronic health conditions, and an emerging body of evidence that these health risks disproportionately impact households of low SES and racial and ethnic minorities. There is increasing concern that these environmental injustices, occurring in the poor and more specifically in the non-white poor populations, are widespread and severe requiring immediate public health and policy action. This home-based environmental risk burden referred to by Evans and Kantrowitz as the “SES health gradient” involves exposure to a collection of well-established hazardous contaminants mitigated through weatherization and healthy housing initiatives.

Results from the American Housing Survey (AHS) conducted by the U.S. Census Bureau, indicate that households of low SES are more likely to be exposed to substandard housing quality than the non-poor, and that, “epidemic increases in asthma in inner-city settings may be partially attributable to elevated ambient pollutants along with exposure to allergens in the home” (Evans and Kantrowitz 2002). This contributes to the Institute of Medicine’s (IOM) (2000) determination that 80% of asthma is allergic asthma and is consistent with the overwhelming evidence that chronic exposure to indoor environmental asthma triggers (Figure 2.1), found in sub-optimal housing, contributes to asthma. Mudarri and Fisk (2007) assert that approximately 20% of asthma cases can be attributed to mold and moisture in the home environment. The Robert Wood Johnson Foundation posits that 40% of preventable medical costs associated with asthma are caused by environmental triggers found inside the home.



 <span data-bbox="836 1018 1031 1066">Asthma</span> 
Environmental Tobacco Smoke (ETS)
Dust Mites
Pollutants from vehicle traffic infiltrating indoors (e.g., diesel exhaust)
Ozone
Outdoor allergens
Cockroach allergen
Rodents
Pets (cats and dogs)
Molds and fungi
Smoke from burning wood
Indoor VOCs
Thermal stress (extreme temps indoors)
Severity of the common cold
Psycho-social stress
Particulate matter from cooking; NO <sub>2</sub>

**Figure 2.1. List of Evidence-Based Environmental Asthma Triggers<sup>3</sup>**

<sup>3</sup> Retrieved from National Institute of Environmental Health Sciences (NIEHS) supported research found at: <http://www.niehs.nih.gov/health/topics/conditions/asthma/index.cfm>

The Stanford Center on Poverty and Inequality Report (2014) revealed health disparities across poverty, race and ethnicity. The brief stated Americans living in poverty to be five times more likely to report being in poor or fair health than those with incomes four times the poverty threshold. The same brief reviewed asthma rates as a health indicator for children and described the resulting racial disparity findings for asthma as “troubling.” African Americans are twice as likely as white children to have asthma and two to three times more likely than any other racial or ethnic group to die from asthma (CDC 2014). Results from the National Surveillance of Asthma (2001-2010) found the rate of ED visits among African Americans with asthma to be 330% higher than Caucasians (220% higher for hospitalizations and 180% higher for death rates). Evans and Kantrowitz (2002) suggests asthma as an epidemic in inner city urban environments can, in part, be attributable to high levels of ambient pollution and exposure to environmental allergens in the home.

A recent study, conducted by Breyse et al. (2014) in Washington State, sought to determine impacts of weatherization-plus-health<sup>4</sup> interventions, in conjunction with in-home asthma education provided by community health workers (CHWs), on asthma-related health outcomes. The Breyse et al. study concluded that participants in the treatment group that received healthy housing interventions in addition to CHW education, compared to those who received CHW services only, observed improvements in IEQ, caregiver quality of life, and child asthma-related health outcomes through improved asthma control. Although the Breyse et al. study has similarities to the ORNL/Opportunity Council study described herein (i.e., target population, housing stock, and a tailored set of healthy housing interventions), the Breyse et al. study’s inclusion criteria limited participation to those with severe asthma and to those with a medical diagnosis. The ORNL/Opportunity Council study included those households eligible for Opportunity Council healthy housing programs and households containing children with any severity of asthma (caregiver-reported). Additionally, none of the study groups evaluated within this report involved CHW education only, while the Breyse et al. report did not collect health insurance data as a method to evaluate impacts on health care utilization and costs.

Several studies confirm that costs of asthma are correlated with severity (Godard et al. 2002; Serra-Batlles et al. 1998; Smith et al. 1997). The Breyse et al. report defined severity based on asthma control levels according to the 2007 National Heart, Lung, and Blood Institute (NHLBI). Participants in the Breyse et al. study met criteria for either not-well-controlled or very poorly controlled asthma. The Godard et al. (2002) study investigating the relationship between severity and costs used spirometry, and other tests according to international standards, to assign participants to one of four asthma severity classifications: 1) intermittent; 2) mild persistent; 3) moderate persistent; and 4) severe persistent. The Godard et al. study not only concluded that overall costs of asthma are correlated with severity, but that this correlation persists for each of the cost categories used; direct, indirect, and quality of life (QoL).

In 2010, Mason et al. conducted a review of economic analyses of housing-related interventions aimed at preventing asthma and other illnesses. This review described five types of economic analysis methodologies common in public health research to value the costs, impacts, and effectiveness of the interventions: 1) Cost of illness (COI); 2) Cost analysis (CA); 3) Cost-effectiveness analysis (CEA); 4) Cost-utility analysis (CUA); and 5) Cost-benefit analysis (CBA). COI studies evaluate all direct and indirect costs of adverse health outcomes attributed to the illness, while CA evaluations calculate all costs of implementing the intervention(s) and may include all costs saved by the intervention (i.e., COI minus total intervention costs). Mason et al. identify CEA as the most common evaluation method in the public health research domain, defined as a ratio of net cost of the intervention per improvement attributed to that intervention. CEA is typically employed to compare the relative effectiveness of one or more interventions or to no intervention. Ultimately, CEA is used to guide decision-makers on best practice when considering whether or not an intervention is cost-effective compared to other practice in efforts to justify additional costs. CUA is considered a version of CEA whereas the health outcome measure

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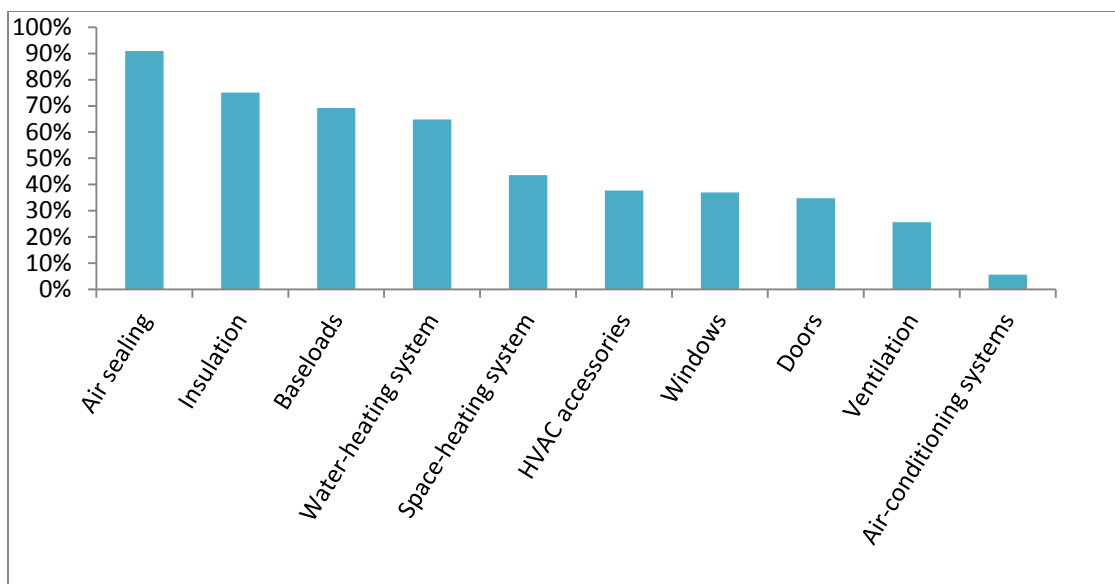
<sup>4</sup> This was not the same Weatherization Plus Health program evaluated for this study.

includes a valuation of QoL; typically quality-adjusted life years (QALY). Mason et al. goes on to describe CBA as the gold standard of economic evaluation methods, as pronounced by other researchers in the field, because CBA compares the costs and consequences of different interventions in monetary terms over time. Comparing disparate interventions in this way allows for consideration of both positive and negative impacts of multiple interventions and allows for prioritization of both benefits and negative consequences attributed to each intervention.

According to the health economics literature, it is common to use national and state-level medical expenditure data to track the prevalence and costs of asthma. (Dombkowski et al. 2005; Kelly et al. 2000; Landrigan et al. 2002; Mason et al. 2010; Smith et al. 1997; MEPS 2015; HCUP 2015; Weiss and Sullivan 2001). The Picoro et al. (2001) study limited costs to asthma-related Medicaid claims in Kentucky (24,365 participants) with a final result estimating total state asthma-related costs to be \$845 per person. The evaluation method conducted for this ORNL/Opportunity Council study employed a similar payer perspective COI design used by Picoro et al. (2001). Section 4.1 of this report describes the ORNL/Opportunity Council study that used Medicaid claims collected for a small cohort of children with asthma to compare the effectiveness of three interventions in Northwestern Washington State in reducing Medicaid costs.

## **2.1 ASTHMA AND WEATHERIZATION**

Weatherization measures (Figure 2.2) directly and inadvertently address multiple evidence-based indoor environmental asthma triggers covered by public health campaigns, such as exposure to extreme temperatures, mold, moisture, cockroaches, mice, dust and other particulate matter, and the hazards of exposure to by-products of combustion from gas cooking stoves and portable unvented heaters. Thermal conditions can also have significant adverse effects on health and mortality especially within the vulnerable populations that WAP serves. The effects of heat are amplified in the elderly, pregnant women, and infants (CDC 2005). People with cardiovascular or respiratory disease, diabetes, obesity, chronic mental disorders, limited mobility, or other preexisting medical conditions, such as asthma, are at greater risk from heat exposure (CDC 2005). Additional risk factors for heat-related mortality include social isolation, low SES, limited educational attainment, poor housing, lack of access to air conditioning, and less availability of health care services (Huang 2011). HVAC maintenance and accessories such as HEPA filters may be included in the weatherization scope of work depending on the needs of the housing unit as determined by an energy audit, and depending on availability of leveraged resources secured by the weatherization provider. While primarily targeting energy efficiency, these heating equipment measures provide tertiary health benefits by addressing air quality issues caused from combustion by-products and dust. Finally, air sealing and insulation can potentially reduce indoor exposure to contaminants generated from the outdoor environment, exposure to extreme hot and cold temperatures, and pest infestations, thereby reducing exposure to evidence-based asthma triggers from mice and cockroach generated particulates. Proper mechanical ventilation is a crosscutting aspect of both weatherization and healthy homes programs that addresses exposure to moisture related problems (e.g., mold), and other IEQ issues (e.g., NO<sub>2</sub> generated from gas cooking stoves).



**Figure 2.2. Frequency of WAP Measures Installed in Homes in PY 2008**

Epidemiologists, exposure scientists and others are currently conducting research that suggests indoor exposure to chemicals may be a more important source of asthma triggers than the usual suite of suspects commonly referred to as environmental asthma triggers listed in Figure 2.1 (Bornehag and Whyatt 2013). Manufactured chemicals and heavy metals inside the home may be introduced into the home through sources such as building materials, solvents, furniture, and plastics or they may have infiltrated from outdoors (e.g., particulate matter from combustion, agricultural dust). Epidemiologists have concluded that the majority of human exposure to manufactured chemicals occurs from inside the home (Little 2013).

One pathway for exposure to these chemicals and heavy metals is through dust. In addition to substantial amounts of squamous (human skin cells), household dust may contain a wide range of contaminants harmful to human health including, but not limited to, flame retardants, persistent organic compounds (POCs), semi-volatile organic compounds (SVOCs) released from vinyl flooring, and other manufactured chemicals. One such substance is a plasticizer (phthalate) found in toys and other products. Exposure to phthalates and other endocrine disrupting chemicals is statistically correlated to respiratory diseases and infections, and can impact reproductive health (Takaro et al. 2013). Residue from environmental tobacco smoke (known as third-hand smoke) and even from the illegal production of methamphetamine by previous residents are rising on the radar of those worried about the impacts of indoor pollutants on human health over time.

Current research in the field of exposure science suggests that the more dust in the environment the greater chance of exposure to these contaminants through inhalation, ingestion, or skin absorption. Dust from the outdoors may infiltrate the home through open windows, leaky doorframes, and other air leaks in the building's infrastructure. Dust load samples collected from inside homes have contained manufactured chemicals, such as dichlorodiphenyltrichloroethane (DDT) despite having been discontinued for 20 years, and heavy metals such as lead (Stout et al. 2009; Weschler 2013). They also contained various speciation of particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>). These are known contributors and triggers for asthma and other adverse health impacts projected to increase with climate change (Fabian et al. 2013; NIEHS 2015; Melillo et al. 2014; National Research Council (NRC) 2010). Weatherization directly addresses many of these IEQ issues through dust-reduction measures, such as air sealing, the cleaning and replacement of air filters (including HEPA filters) on air supply lines, proper whole-house and localized ventilation, dryer venting, and by implementing lead-safe weatherization practice during

window and door replacement. A study conducted by Sandel et al. (2010), reviewing interventions and control of health-related chemical agents, indicated that particulate intrusion reduction from improved ventilation is a promising intervention that needs further evaluation. This same report indicated the need for more formative research on improved residential ventilation stating, “too little is known about how ventilation levels affect both short- and long-term health.” Overall, studies show that inadequate ventilation adversely affects health, but that more formal research is necessary to further our understanding of different types of systems in relation to housing and household characteristics and IEQ.

Drafts in a home may indicate how well sealed the home is from infiltration of outdoor particulate matter. The WAP national occupant survey (Tonn et al. 2014) reports a reduction from 29% of those reporting their home drafty most or all of the time to 9%. Also supporting this observation are findings from ORNL’s social network study, “Weatherization Experiences,” another component of the national WAP evaluations (Rose et al. 2015). Members of social networks who had weatherization work completed at the suggestion of other WAP recipients reported observations related to IEQ post-weatherization. Of those who had weatherization work completed, 55% reported less drafts in the home and 44% of respondents reported the home being less dusty.

Low-income weatherization can reduce poverty-related stressors faced by occupants as a result of direct energy and non-energy related benefits. Chronic stress is an evidence-based risk factor for adverse health implications associated with the release of stress hormones; in particular, cortisol. High doses of cortisol released as a result of chronic stress correlates with a variety of health problems including cardiovascular disease, obesity, anxiety disorders, and asthma (NIH 2002). Chronic stress as it relates to exposure to psychosocial stress is recognized as a symptom of poverty.<sup>5</sup> Conversely, of those Americans who reported having a major stressful event in the past year (49%), 43 percent reported that experience being related to health, and those identifying as being in poor health were twice as likely (60%) to report being under a “great deal” of stress within the past month (NPR 2014). The same poll finds that 36% of households with an income < \$20,000 reported experiencing high stress levels within the past month. Research presented at a recent Roundtable on the Health and Well-Being Impacts of Energy Efficiency Improvements, hosted by the International Energy Agency (IEA), found that it only takes a few stressors in one’s life to have a significant negative impact on mental health and that the detrimental effect of adding stressors seems to be exponential, not linear (Liddell 2013). Liddell also states that greater residential stability reduces stress and related adverse health outcomes. McGhan et al. (2006) found that children with poorly controlled asthma has significantly worse scores in the areas of confidence in management their asthma, fear of dying, and QoL related to social and sport activities, and school performance and attendance.

Physical effects of exposure to poor IEQ, such as asthma and allergies, may result in loss of productivity at home and work either through absenteeism or presenteeism.<sup>6</sup> Loss of productivity through absenteeism may result in financial stress. Family dysfunction as a result of inhibited productivity in the home can also lead to chronic stress through increased dependence on formal and informal social networks for support and perceived lack of control and uncertainty around meeting the basic physiological needs of household members. Family dysfunction and symptoms of parental depression and psycho-social stress can then lead to *child* exposure to psycho-social stress. Family functioning and well-being promotes secure attachment between caregivers and children, reducing both parental and child exposure to psycho-social stress and allows children and adults to tend to educational and professional needs. Insecure or dysfunctional attachment patterns between children and parents can result in the disruption of child developmental milestones, low self-confidence, -esteem, and -worth and may interfere with a child’s ability to develop schemas around healthy attachments to others including other adults, peers and future

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<sup>5</sup> Psychosocial stress is experienced when individuals face complex and stressful living conditions.

<sup>6</sup> “Presenteeism occurs when an employee goes to work despite a medical illness that will prevent him or her from fully functioning at work,” <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2947637/>



offspring (Wong et al. 2002; Jacobsen and Hofmann 1997). Children with observed insecure or dysfunctional attachment and those developmentally immature are at greater risk for poor school performance and unruly, delinquent and sexually risky behaviors; having impacts at both household and societal levels (Levi and Orlans 2000; Coleman 2003). A recent study conducted through the MacArthur Foundation's How Housing Matters Research Initiative found that poor housing quality contributes to emotional and behavioral problems in children and that "much of this association operates through parental stress and parenting behaviors" (Coley et al. 2013). By improving the quality of the dwelling, weatherization has the potential to reduce parental stress, thereby improving availability and attachment between the caregiver(s) and the children in the home that then affords those children the opportunity to better address developmental milestone achievement and improved behavior and performance. Ameliorating the physiological and psychological symptoms of poverty through work like weatherization is an under-realized benefit.

Simulated models of the effects of building interventions and IEQ (measuring pollutant concentrations indoors) on pediatric asthma outcomes in low-income multifamily buildings suggest that weatherization measures targeting the sealing of the building envelope led to an increase in pollutant concentration of NO<sub>2</sub> and PM<sub>2.5</sub>. That increase predicted 20% more serious asthma events, but that bundling weatherization with repairing kitchen exhaust fans mitigated this adverse impact (Fabian et al. 2013). This study looked at the intersection of weatherization, IEQ and health with particular attention to pediatric asthma. Fabian et al. go on to state, "Without evidence of changes in health care use, it is difficult to develop public health or policy actions."

Numerous papers discuss the effectiveness of multi-component interventions on the severity and incidence of asthma episodes by addressing multiple triggers in the home environment (Breyse et al. 2014; Crocker et al. 2011; Dixon et al. 2009; Godard et al. 2002; Kelly et al. 2000; Krieger et al. 2010; Sullivan et al. 2002). In addition to averted medical costs associated with hospitalization and ED visits due to asthma, there is evidence to suggest that weatherization acts, in part, as a home-based multi-trigger or multi-attribute asthma reduction program providing additional benefits beyond urgent care (Crocker et al. 2011; Godard et al. 2002; Sullivan et al. 2002). These benefits are observed through other direct medical costs (e.g., reduced prescribed medicines, office and clinic visits, and hospital outpatient) and indirect costs (e.g., reduced housekeeping loss, loss of work and school productivity, and restricted activity) (Dombkowski et al. 2005; Smith et al. 1997; Norton 2015). Wang et al. (2005) estimated the total economic impact of asthma in school-aged children for 1996 to be \$1993.6 million or \$791 per child with asthma.

A recent evaluation of the health and household benefits of weatherization begins to attribute the benefits of asthma trigger reductions inside the home to WAP through self-reported changes in morbidity and use of urgent care facilities from pre- to post-intervention (Tonn et al. 2014). The data mentioned in the ORNL non-energy benefits report suggest that weatherization is associated with fewer ED visits due to asthma. The analysis used health care cost data from the National Medical Expenditure Panel Survey (MEPS) and through the National Healthcare Utilization Project (HCUP) to monetize cost savings from reduced ED visits (by 11.5%) and hospitalization (by 3.1%) post-weatherization at both societal and household levels. To monetize potential reductions in averted medical costs and indirect costs beyond urgent care treatment attributable to WAP, a methodology was developed by the ORNL team to determine the percentage of respondents identified as "high-cost" asthma patients pre-weatherization, but then identified as "low-cost" asthma patients post-weatherization. High-cost asthma patients account for two-thirds of the ED visits and hospitalizations due to asthma in the U.S. (Smith et al. 1997). Those who reported having asthma symptoms within the last three months were counted as high-cost asthma patients and those who reported last having asthma symptoms greater than three months were identified as low-cost asthma patients. The Smith et al. study findings were then used to calculate the direct and indirect cost savings associated for each of the two groups. Using these data, the total health benefits associated

with asthma, attributable to WAP per home in 2008, was \$202 and the present value (PV) per home was calculated to be \$2,009 (Tonn et al. 2014).<sup>7</sup>

A comprehensive review of past research has provided evidence that indoor air pollutants are a frequent cause of illness and that residential energy efficiency measures and green interventions have improved indoor air quality and occupant health. However, other studies have recognized that a “too tight” building envelope could exacerbate indoor air pollution if appropriate precautions and measures are not considered (Fisk 2000). Research has also been conducted that focused specifically on asthma morbidity reductions and other non-energy benefits, such as productivity gains, due to weatherization. Two U.S. studies on new, green construction have demonstrated significant respiratory health improvements (Heyman et al. 2005; Takaro et al. 2011). A 2005 World Health Organization (WHO) report concluded there are direct linkages relating energy efficiency of housing and health with sufficient evidence for estimating the burden of disease. Programs retrofitting affordable housing with green and healthy interventions directly reduce health problems associated with poor quality housing by limiting exposure to allergens, neurotoxins, and other dangers (Breysse et al. 2004; Sandel et al 1998).

One study recently attempted to determine key predicting factors for high health care utilization or super-utilizers<sup>8</sup> among Hispanic and African American children (Rastogi 2013). The study revealed that caregiver knowledge alone of asthma pathophysiology, control, and treatment does not adequately prevent high health care utilization. Participants in the study reported feelings of stress and helplessness, an inability to implement the actions learned, and on-going use of the ED. Although the authors of the study reported that high health care utilizers had fewer ED visits post-targeted educational interventions, many of the asthma trigger reduction measures remained beyond the capabilities of the household to complete on their own without additional services or support.

Targeted public health education is delivered alongside the healthy homes and weatherization measures provided through the Opportunity Council. Opportunity Council is in a unique position as both a CAA and WAP subgrantee with the ability to implement asthma-reduction measures to mitigate observed and known asthma triggers in concert with weatherization at no cost to the occupant. This is important as asthma is a health disparity impacting households of low SES at a greater rate than those in higher income brackets. The impetus for the research study described in this report was to determine if the bundling of services provided through the Opportunity Council positively impacts the health and well-being of the recipients of these targeted programs, thereby reducing the utilization and cost of health care. More specifically, this research initiative sought to demonstrate any changes in the number of asthma-related Medicaid claims and costs post-intervention for three study groups that offer unique sets of housing-related services.

Targeting the “high-cost” health care users or super-utilizers of the health care system could maximize the benefits of the Weatherization Plus Health model, as observed in the Sullivan et al. (2002) study. An information bulletin published by the CMCS (2013) reported that 5% of Medicaid beneficiaries account for 54% of total annual health care expenditures; approximately 60% of those beneficiaries that were among the most expensive 10% in one year remained the most expensive for two subsequent years (Coughlin and Long 2010). Another economic analysis of asthma observed that 20% of individual cases in the National Medical Expenditure Survey accounted for 80% of all asthma-related costs (Malone et al. 2000). Studies investigating this topic have revealed that socioeconomic distress, chronic illness, high use

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<sup>7</sup> Results from this analysis show that the present value (PV) per household of all health-related benefits of the ~ 80,000 single family and mobile homes served by WAP in PY 2008 is estimated to be approximately \$14,148.

<sup>8</sup> The Center for Medicaid and CHIP Services (CMCS) defines super-utilizers as those “beneficiaries of complex, unaddressed health issues and a history of frequent encounters with health care providers.”

of other health care resources, substance abuse, and mental illness are associative factors for ED visits and other health care utilization (Sun et al. 2003).

## 2.2 OVERVIEW OF ASTHMA MORBIDITY IN WASHINGTON STATE

The CDC publishes statistics related to asthma morbidity and mortality by nation, by state, and by population. The report completed by the National Center for Environmental Health (NCEH), and published by the CDC's National Asthma Control Program (NACP),<sup>9</sup> reports the following statistics for 2007:

- Child<sup>10</sup> asthma prevalence in Washington State was 6.9% compared to the U.S. rate of 9.0%.
- Asthma prevalence for children in Washington State aged 12-17 was 9.9% (10.5 for U.S.). U.S. rate for children aged 5-11 is 11.0%.
- Boys (at 8.7%) had higher asthma prevalence than girls (at 5.1%).
- For American Indians and Alaska Natives in Washington State, asthma rates are much higher than the state average<sup>11</sup>

No statistics were available in this publication on race or ethnicity except for the white population with an asthma prevalence of 5.6%. Also not reported at the state level are mortality rates for children. However, the overall, age-adjusted mortality rate for Washington State in 2007 was 10.2 per million compared to the U.S. rate of 11.0 persons per million.

The following vital statistics were reported from the National Health Interview Survey (NHIS) conducted in 2012 (Bloom et al. 2012). These most recently available national statistics are presented here to aid in the discussion on asthma as a health disparity in the U.S.:

- Children in poor families were more likely to have ever been diagnosed with asthma (19%) or to still have asthma (13%) than children in families that were not poor (12% and 8%).
- Children in fair or poor health (40%) were three and one-half times as likely to have ever been diagnosed with asthma and almost five times as likely to still have asthma (37%) as children in excellent or very good health (12% and 8%).
- The highest U.S. rate for one race is that for black or African American with rates of 16.0%.

Although the state level asthma rate for Washington is lower than the U.S. rates, this health condition continues to impact households of lower SES, and within communities of color despite geographic location.

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<sup>9</sup> Retrieved from: [http://www.cdc.gov/asthma/stateprofiles/asthma\\_in\\_wa.pdf](http://www.cdc.gov/asthma/stateprofiles/asthma_in_wa.pdf)

<sup>10</sup> Includes persons in WA aged 0-17.

<sup>11</sup> CDC. Retrieved from: <http://www.cdc.gov/nceh/tracking/success/washington.htm#helping>



### 3. WEATHERIZATION PLUS HEALTH

The Opportunity Council is a CAA serving Whatcom, Island and San Juan Counties in Washington State. The Weatherization Plus Health program was started in the early 1990s after Opportunity Council representatives, at a meeting with Native American tribal leaders, observed that the elders of the tribe were using inhalers while leading discussions of the asthma rates prevalent in their tribes. Many homes had electric baseboard heat and wood stoves. Mold was often observed around the colder perimeter of the homes. In 2002, the Indoor Air Coalition of Whatcom County decided that the Opportunity Council should add IEQ to its portfolio since the program was already in WAP income-eligible homes completing audits and addressing ventilation. The Opportunity Council received a HUD Healthy Homes grant to work with a consultant in developing the Weatherization plus Health protocol. Currently, a private foundation finances the Weatherization Plus Health program for homes that have one or more child with asthma under the age of six. DOE has adopted the program name “Weatherization Plus Health” with permission of the Opportunity Council.

The Opportunity Council’s Healthy Homes program encompasses services that range from in-home education and asthma interventions to full Weatherization Plus Health services. In addition to a comprehensive education component, interventions and tools include HEPA filter vacuum cleaners, mattress and pillow encasings, green cleaning kits, and hard-surface flooring (carpet removal). The Healthy Homes measures (Figure 3.1) are all measures observed in the invoices collected for this study. Households might receive a simple package of measures (e.g., HEPA vacuum, cleaning kit, dust mite covers) or a full package of measures requiring contracted work (e.g., carpet replacement with hard-surface flooring, mechanical ventilation). Weatherization services and further IEQ assessments are incorporated into projects depending on household need, eligibility, and program funding.



**Healthy Homes Program**

Targeted asthma education
Advanced ventilation
Laminate and hardwood flooring (carpet removal)
Rodent and pest exclusion
HEPA <sup>12</sup> floor vacuum
Dust mite mattress, box spring, and pillow covers
Entry mat
Cleaning kit
Humidistat
Dehumidifier
Chimney cleaning

**Figure 3.1 List of Opportunity Council Asthma Trigger Reduction Measures**

<sup>12</sup> High-efficiency particulate arrestance (HEPA) is a type of air filter “capable of capturing particles of 0.3 microns with 99.7% efficiency” as defined by the U.S. Environmental Protection Agency (EPA). The EPA defines a HEPA vacuum as a vacuum that has a HEPA filter as the last filtration stage and is designed so that all the air drawn into the machine is expelled through the filter with none of the air leaking out. Retrieved from; <http://www.nifiskcfm.com/vacuum-applications/EPALeasRRP-hepa-vacuum.aspx>

The Weatherization Plus Health concept is integrated into each of the Opportunity Council programs and is considered by each of the program coordinators when assessing family needs. The energy advocate conducting the initial assessment of the home is often the one who identifies the home as a potential Healthy Homes or Weatherization Plus Health project. Homes can be slated to receive a Healthy Homes only package for a myriad of reasons (e.g., deferral of weatherization due to outstanding housing-related issues). Both energy advocates and WAP auditors are trained to identify asthma triggers, such as the presence of rodents, insects and dust.

The Community Services department, which delivers the Energy Assistance program (a primary source for both weatherization and Healthy Homes referrals), schedules the weatherization pre-assessment and then the weatherization itself. While most opportunities to make homes healthier are identified through the Energy Assistance pre-assessments, the Opportunity Council also receives direct referrals for Healthy Homes projects through its Head Start and early-learning programs.

In addition to DOE's interest in weaving Healthy Homes protocols in with energy efficiency, the Opportunity Council has worked with the state of California and EPA in designing their program and in continuing to connect the Healthy Homes, IEQ, and energy retrofit programs. Although the original HUD grant targeted homeowners and child-care providers, renters are now eligible for Weatherization Plus Health. The Opportunity Council continues to consider what other populations should be targeted for Healthy Homes assessment and action, as well as, where agency partnerships might improve efficiency and prove effective.

## 4. STUDY DESCRIPTION

WAP serves households of low socioeconomic status to achieve energy efficiency through home energy retrofit and energy consumption education. The mission of WAP also involves addressing health and safety concerns as they relate to home energy. To be eligible for the Program, households must have an income of 200% of the federal poverty level or less. It was the assumption that many of the households served by WAP also receive Medicaid or another form of health care assistance. Medicaid records were requested for Opportunity Council household members with asthma and collected from the Washington State Health Care Authority (HCA) to measure potential changes in costs related to asthma morbidity. This transfer of data involved; (1) approval from the Washington State Institutional Review Board (WSIRB); (2) the Opportunity Council requesting and receiving authorizations for the disclosure of Medicaid records from both treatment and comparisons groups; (3) submitting the authorization forms to the HCA through a secure file transfer protocol (FTP); and (4) receiving asthma specific Medicaid records back from the HCA using the same secure FTP. The Opportunity Council partnered with ORNL on this task and with entering the data into a database for future analysis by ORNL. The dataset was de-identified of personally identifiable information (PII) prior to ORNL reviewing the data to reduce the risk of breach of confidentiality. Study identifiers were given to participating households and to individuals for the linking of all data collected. The minimum data elements were requested from HCA capturing all asthma-related claims, including the type of claim and costs. The research plan was to identify relationships between the programs delivered to households with children with asthma and any changes in direct medical expenditures related to asthma as evidenced through the disclosure of records.

### 4.1 METHODOLOGY

A quasi-experimental design for this retrospective evaluation was adopted to compare results between two programs operated under the Opportunity Council services umbrella: Healthy Homes and Weatherization Plus Health. The impacts of these two programs were to be compared not only to each other, but to standard WAP services delivered through other CAAs in WA State as a means to discern potential impact of these programs on children with asthma within the WAP eligible population. The COI under study was limited to asthma-related costs of Medicaid recipients in Washington State and therefore applied a payer perspective, similar to the Piccoro et al. (2001) study described in section 2 (Corso and Fertig 2009). Utilization of Medicaid data as primary data reduces bias inherent in self-reported information, while corroborating the narrative provided by both survey research and anecdotal evidence.

The study aimed to answer the following research questions: (1) Does the Opportunity Council's Weatherization Plus Health program result in decreased direct medical expenditures related to asthma treatment? (2) Do the direct medical expenditures also correlate with self-reported and caregiver reported improvement in health related asthma symptoms and episodes? (3) Does the level of impact on direct medical expenditures correlate with specific weatherization or asthma reduction measures provided through Weatherization Plus Health? (4) Are relationships observed between the Weatherization Plus Health program, asthma morbidity and health care, and school on-site care and attendance? (5) If relationships are observed, what are the cost savings related to the decrease in direct medical expenditures, increased school attendance, performance, and on-site care, and caregiver productivity? (6) What do the relevant physicians attribute change in asthma status and episodes to? and (7) Are there any adults with asthma in the household that self-report a change in their own asthma conditions as a benefit for treating the home for the children?

#### 4.1.1 Research Design

This study implemented a quasi-experimental approach for evaluating the impacts of three different program types on asthma morbidity in a sample of Medicaid-insured persons. This involved collecting data for a control group (i.e., WAP Only) and comparing the results to those observed for the treatment groups (i.e., Weatherization Plus Health and Healthy Homes Only). The primary reasons for using quasi-experimental design was due to the retrospective nature of the study and because the Opportunity Council did not randomly assign households to different programs at the time of intervention. It is understood that a randomized control trial (RCT) design offers benefits as an experimental approach. However, there are compelling reasons, explained in this subsection, why a quasi-experimental design was chosen instead.

According to a recent Government Accountability Office (GAO) report, “program evaluation literature generally agrees that well-conducted randomized experiments are best suited for assessing effectiveness when multiple causal influences create uncertainty about what caused results.”<sup>13</sup> The GAO report goes on to note, however, that randomized experiments “are often difficult, and sometimes impossible, to carry out,” and that “requiring evidence from randomized studies as sole proof of effectiveness will likely exclude many potentially effective and worthwhile practices.” When randomized studies are impractical or impossible to carry out, quasi-experimental comparison group studies satisfactorily provide “rigorous alternatives to randomized experiments.” For legal and practical considerations, we believed that a classical (RCT) approach could not be implemented to evaluate WAP during the ARRA period.

Additionally, WAP is administered by States (i.e., grantees) through subgrantees that must prioritize WAP applicants in order to select them. The primary barrier to randomization in a WAP evaluation is in fact legislative priority constraints on how the subgrantees should prioritize WAP applicants. From the U.S. Department of Energy, Weatherization Assistance Program for Low-Income Persons, Title 10, Part 440 (Direct Final Rule, *Federal Register*, June 22, 2006)<sup>14</sup>:

*Section 440.16 Minimum program requirements... (b) Priority is given to identifying and providing weatherization assistance to:*

- (1) Elderly persons;*
- (2) Persons with disabilities;*
- (3) Families with children;*
- (4) High residential energy users; and*
- (5) Households with a high energy burden.*

Thus, Title 10, Part 440 essentially prohibits the purely random assignment of WAP applicants to control groups, meaning that the RCT approach is not possible.

In conjunction with Title 10, Part 440, there is also a practical and perceived moral obligation among subgrantees to provide services to all applicants—and particularly to high-priority applicants—as fairly and expediently as the Program will allow. This institutional resistance to random assignment to and the consequential delay of service to control groups would have to be overcome before an RCT could be correctly implemented.

At the time of the study design, it was believed that WAP alone would have minimal impact, if any, on asthma morbidity because it did not purposefully target home-based environmental triggers associated with asthma and also because there is an on-going debate within the home performance industry on

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<sup>13</sup>“Program Evaluation: A Variety of Rigorous Methods Can Help Identify Effective Interventions,” GAO-10-30, November 2009.

<sup>14</sup> See <http://www.waptac.org/sp.asp?id=1812#minimum>.



whether WAP contributes to worsened IEQ after air-sealing a home. However, results from an occupant survey delivered to a random selection of WAP recipients provided statistically significant results indicating improved outcomes related to asthma morbidity and reduced use of urgent health care facilities (Tonn et al. 2014). Based on these results, it became evident that analysts involved with this study would need to consider the results from the Opportunity Council sample in comparison to the WAP group, but that the WAP Only group could no longer be used as a true comparison group with no anticipated change.

#### 4.1.2 Limitations

This retrospective evaluation of the impacts of asthma reduction measures on environmental triggers in the home utilized a quasi-experimental design, which has less internal validity than a randomized control trial. Additionally, this study did not include a comparison group composed of individuals who had received no intervention at all. Further research with either an experimental design or a quasi-experimental design with a larger sample and a non-treated comparison group could allow causal statements to be made. Considering the aforementioned limitations, we aimed to determine through this study: (1) whether or not linkable data can be extracted from institutions housing sensitive health information in order to make the necessary observations to state causal relationships; (2) if any statistically significant relationships exist within the data collected; and (3) whether or not the observed results lead us to believe that further exploration is worth the level of effort required for a true experiment or big data project.

## 4.2 DATA COLLECTION

Approval from WSIRB<sup>15</sup> was required prior to the collection of HCA Medicaid records. IRB approval is required for such research endeavors involving human subjects. The “Weatherization Plus Health Study” application was submitted for expedited review and was initially submitted on November 1, 2012. After two rounds of revisions made by the study team, WSIRB approval was achieved on July 2, 2013.<sup>16</sup> It should be noted that as a condition of approval, HCA staff first determined that the study was of mutual benefit to their program. This determination was made by HCA in October 2012.

The Opportunity Council was responsible for the collection and management of the data. One full time equivalent (FTE) evaluation coordinator, working closely with the Department Director and Manager, was hired for a term of sixteen months. The evaluation coordinator was responsible for scheduling and conducting home visits in treatment and comparison samples, responsible for most post-visit data collection, data entry and file management. As a requirement of IRB approval and a general best practice, all researchers were required to provide proof of receiving training in protecting human research participants and Health Insurance Portability and Accountability Act of 1996 (HIPAA)<sup>17</sup> compliance.

### 4.2.1 Participant Inclusion and Recruitment

#### *Inclusion Criteria*

Study inclusion criteria were carefully considered by the research team to ensure that the final samples would be representative of the population the Weatherization Plus Health initiative sought to target for improved health outcomes. The following set of criteria was used for inclusion:

- Homes must have received: 1) Weatherization Plus Health services OR 2) Healthy Homes interventions through the Opportunity Council OR 3) WAP Only (1 year prior to study) through participating WAP agencies;

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<sup>15</sup> <https://www.dshs.wa.gov/sesa/research-and-data-analysis/human-research-review-section>

<sup>16</sup> See the complete WSIRB application in Appendix C.

<sup>17</sup> The HIPAA Privacy Rule provides federal protections for individually identifiable health information held by entities and covers patients’ rights with respect to the disclosure of that information. <http://www.hhs.gov/ocr/privacy/hipaa/understanding/>

- The same child(ren) for whom services were employed, continued to reside within the home for the duration of the pre-intervention (1 year) and post-intervention time periods;
- The family continued to reside in the same house where the intervention occurred; and
- The legal parent/guardian(s) agreed to participate in the study.

*Treatment sample*

During the WSIRB approval process, the ORNL and Opportunity Council team engaged in the study’s participant identification and recruitment phase. Using search filters in the Weatherization and Conservation Education databases, a list of 125 potential homes was produced. Recipients of the Opportunity Council programs were excluded if they no longer resided in the home where services had been delivered. From this sample, 34 households were scheduled for visits and included in the study. Individual case files were further mined to determine the type of Healthy Homes packages that households had received: the full package (e.g., carpet removal) or a simple package delivered through a one-time visit to the home where products were distributed to households at that time (e.g., HEPA vacuum).

*Comparison sample*

The study worked with three comparison WAP agencies in the region – Snohomish County; Housing Authority of Skagit County; and Community Action Council of Lewis, Mason, and Thurston Counties - to collectively provide the comparison sample (i.e., WAP Only group). In Snohomish County, eligible program year files were sorted through by hand to determine that the household had an occupant with asthma and a child between 0-10 at the time of weatherization. From a sample of nearly 60 homes, 8 were included in the study.<sup>18</sup> Outreach efforts were made to WAP agencies in surrounding service territories to improve the sample size. Skagit County was able to screen their database for the requisites but was only able to provide 15 potential households, of which two were included. The Lewis, Mason and Thurston weatherization department was not able to screen their database and provided the Opportunity Council with a sample of over 150 households, only five of which participated in the study. The total number of comparison households was 15; 21 children in total). The average number of months for which data were collected post-intervention ranged from 24-28 (Table 4.1).

**Table 4.1. Average (Mean) Number of Months Between Program Delivery and Post-Intervention Data Collection**

	# of months (mean)	Range (in months)
Wx + Health	26	3-47
Wx Only	28	6-52
HH Only	24	6-44

Prior to calling homes to schedule potential study participants, each household received an introduction letter explaining the study and informing the residents that they would be receiving a phone call to schedule the visit. The letters also asked residents to contact the Opportunity Council if they were interested in participating. One week later, potential participants were called to schedule their in-home visit. The initial round of calls served mostly to screen the sample for eligibility, wrong or disconnected numbers, and people who had moved since receiving Healthy Homes or WAP services. Once a household was contacted and eligibility was confirmed, an overview of the visit was discussed, including informing the participants of the potential benefits and consequences of participating in the study.<sup>19</sup> The introduction

<sup>18</sup> Reasons for only 8 of the 60 potential homes included in the study: (1) staff was unable to determine if the person with asthma in the home was a child between 0-10 years old until making further contact; (2) family may have moved from the home; (3) family not interested or unable to participate.

<sup>19</sup> See Informed Consent in Appendix A.

letter and the informed consent drafts were reviewed for readability at or below the 8<sup>th</sup> grade reading level<sup>20</sup> using the Flesch-Kincaid test; a Microsoft Word document function.

The following survey and data collection instruments were used by the study team at the time of the intervention (Appendix A):

- Weatherization audit, scope of work, and work completed (DF2)
- Asthma Home Environment Checklist, Action Plan, and work completed
- Asthma Control Test (symptoms) pre- and post-intervention
- Satisfaction survey

The following survey and data collection instruments were administered by the study team over the course of the study (Appendix B):

- Occupant Survey post-intervention (study instrument)<sup>21</sup>
- Home walk-through post-intervention (study instrument)
- Medicaid records pre- and post-intervention
- Physician records pre- and post-intervention

#### 4.2.2 Home Visits

Opportunity Council staff pre-tested the on-site home visit in two homes in August of 2012. The visits averaged 1.5 hours each. Both the walk-through observation and survey instruments were tested with no concerns voiced or observed. However, it became apparent that caregivers desired the opportunity to confer with their partners prior to signing the HCA authorization forms releasing Medicaid data for the study. It was agreed that the importance of authorization should be effectively communicated during the recruitment phase and as part of the initial informed consent. This allowed time for discussion and agreement between caregivers prior to the home visit in efforts to avoid a second visit to the home.

The home visits were conducted between May 2013 and January 2014. They took approximately one hour to complete and families received a \$200 incentive check for participating. Home visits involved a detailed informed consent component, data collection (i.e., occupant survey and walk through data form), and signatures on HCA authorization and release of information forms. Certified medical translators accompanied visits for households where English was a second language, and all forms were translated into the primary first language.

The home visit procedures and data collection were based on previous weatherization studies for the ARRA-era WAP evaluations. After completing the informed consent procedures and answering any initial questions, a home walkthrough and checklist was completed to verify the condition of the home and take note of any issues that may affect IEQ. The researcher then worked with the participant to complete forms including an asthma control test with any asthmatic children and releases of information for physician and Medicaid records. Next an occupant survey was administered covering heating and ventilation, home conditions, health care and coverage, health and well-being, IEQ issues, and employment and demographic characteristics. Once these forms were completed and verified the home visit was concluded.

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<sup>20</sup> 8<sup>th</sup> grade reading level and below is the WSIRB required standard for documents provided to human subjects.

<sup>21</sup> The post-intervention occupant survey was paid for and administered by the Opportunity Council

### 4.2.3 Database Development

A custom Microsoft Access database was built by the ORNL WAP evaluation subcontractor, APPRISE, to house data collected in the program files and data collected during the study. The database comprised of modules that corresponded with each survey instrument, data collection form, and records fields requested through HCA. Modularization allowed for modules to be updated and debugged as needed by APPRISE, allowing work to still be entered even as modules were being updated. A final de-identified data file was uploaded to ORNL using ORNL's Secure File Transport (SFT). An identified back up database copy was retained and consulted as needed to resolve data issues.

### 4.2.4 HCA Medicaid Records Collection

A "minimum necessary" data request was submitted to HCA for a data share agreement to be established with a data transfer protocol and system identified (FTP secure site). The HCA data set included the following items for each of the authorization forms submitted. Upon authorization, HCA released the requested information to the Opportunity Council and ORNL analysts listed on the WSIRB application:

- *Program type*; As HCA manages records for both Medicaid and state program recipients, the program type for each claim was requested.
- *Claim type*; ALL professional, outpatient, home health, pharmacy and inpatient claims related to asthma in their final state were requested.
- *Diagnosis codes*; All 6 asthma ICD-9 codes starting with 493 were pulled at both the header and line levels for all paid and final encounter claims.<sup>22</sup>
- *Primary diagnosis*; All claims where the 493 ICD-9 code appears as either the primary or after the primary diagnosis (diagnosis 2, 3, 4, etc.).
- *Paid amount*; 493 ICD-9 codes were pulled for all paid and final encounter claims and included all paid amounts for that line claim.
- *Billing provider information*; HCA provided both the billing provider ID, name, and billing provider for all claims.
- *Servicing provider identification*; HCA provided both the servicing provider and name of the service provider for all claims.
- *Procedure codes*; HCA provided procedure codes and names for all services provided and the quantity of each.
- *Revenue codes*; The revenue code and name in cases where services are bundled for billing were provided.
- *Recipient Aid Category (RAC)*; RACs were pulled to inform the study which recipient category the client belongs to.
- *Pharmacy claims*; HCA provided the National Drug Code (NDC), the drug generic name, the unit of measure, and the paid amount for that claim.

HCA Medicaid requests were handled by the department manager. HCA authorization forms were gathered releasing information to both Opportunity Council and ORNL (2 releases). Scans of the releases for each family were uploaded along with a request spreadsheet to a dedicated HCA contact through the secure FTP operated by HCA. HCA staff compiled the Medicaid records into a single spreadsheet within 3-5 days and delivered it using the FTP. The department manager compiled all returned records spreadsheets into one master spreadsheet organized by building ID # using a, b, c... to identify

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<sup>22</sup> International Classification of Diseases, Ninth Revision (ICD-9) codes were used for the HCA request for records. All header or line claims with any ICD-9 asthma codes (codes starting with 493) listed as either primary or secondary diagnosis were requested.

individuals with asthma within the home. The spreadsheet was de-identified and sent to ORNL using secure FTP operated by ORNL.

#### 4.2.5 Data Transfer to ORNL analysts

Opportunity Council staff sent the de-identified database with linkable study identifiers at the household and individual levels through ORNL's File Upload System. This system uses secure FTP and is operated through ORNL's Information Technology Services department. Opportunity Council staff uploaded the complete database and other records using this ORNL file upload system. Other security measures were established to protect the confidential information collected through this study.<sup>23</sup>

#### 4.2.6 Data Collection Challenges

One primary challenge the research study faced was the timeline of the WSIRB approval. The research work scope was finalized, but the researchers were unable to request Medicaid records without IRB approval. The decision was made to move forward with the first round of visits that consisted of all parts of the visit except gathering the HCA Medicaid releases. Families received \$100 for this visit with the agreement to issue the remaining \$100 after Medicaid releases were collected following IRB approval. Most homes required a second visit to complete the forms, and some households stopped participating in the evaluation before a second visit could be completed to gain the Medicaid releases.

A second challenge faced was the size of the treatment and comparison samples. In the treatment sample, while the program served over 125 families, the final sample included only 34 households with 52 individual cases. This was due to families moving, out of date contact information, or lack of interest in participating. There were similar issues in the comparison sample.

Working with three different WAP agencies, each with their own databases and standards for information collection, made screening participants challenging. While the control agencies submitted encouraging sample sizes, the final comparison sample was small. We learned that there is inconsistency in how asthma prevalence is recorded in WAP files. Washington State, as the WAP grantee, does not have a requirement for this information to be recorded and some agencies do not capture it at all. Phone screening was completed prior to scheduling to insure eligibility. Some comparison group families also had legitimacy concerns about the study. Though letters of introduction were mailed, including a cover letter from each comparison group agency, most potential participants were not aware of the Opportunity Council. This, combined with the difficulty of explaining the broad overview of the study, caused some to be hesitant to schedule the home visit and participate.

Accessing physician records posed an additional challenge to measuring program impacts on health. It took many months working with the primary care provider networks in the area to receive the first batch of records, despite authorization from participating households releasing this information.

The final challenge faced was attempting to request school records. The sample had very few children in elementary school during the study time frame. A decision was made by the study team not to continue pursuit of school records, as there would be little comparative data to look at from year to year. This component of the study would have required working with at least 6 school districts in the treatment group counties and many more in the comparison group counties. It was decided that due to the low number that were enrolled in school during the study time period, school records would not be sought.

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<sup>23</sup> ORNL's Electronic Data Security Plan was approved by WSIRB.



## 5. DESCRIPTIVE STATISTICS FROM THE STUDY SAMPLE

Results from the AHS conducted by the U.S. Census Bureau indicate that households of low SES are three times more likely to be exposed to substandard housing quality than the non-poor (Evans and Kantrowitz 2002). Findings from questions posed to WAP recipients as part of the national evaluation about the physical condition of their homes pre- and post-weatherization revealed that the physical condition improved post-weatherization. The largest reported change was related to homes being less drafty post-weatherization. This was not an unexpected result considering over 90% of WAP homes in PY 2010 received some sort of air sealing measure during the weatherization process. The results also suggest that insulation, air sealing and other measures have the potential to protect homes from dust, and mice and cockroach infestation and their generated particulates, which are all known evidence-based asthma triggers. Occupant-reported observations of moisture issues and mold inside homes reduced from 28% pre-weatherization to less than 20% post-weatherization (Tonn et al. 2015). Comparable findings suggesting reductions in moisture issues were also observed within groups participating in this study.

The following six subsections capture descriptive statistics extracted from a combination of pre- and post-intervention survey instruments (discussed in more detail in Section 5.2) administered to occupants of the three groups that participated in this special study and are grouped into these categories:

- Characterization of Study Participants and Housing Units
- Presence of Home-Source Evidence-Based Asthma Triggers
- Allergy Reduction Measures
- Impacts of Weatherization and Healthy Homes Education
- Weatherization and Healthy Homes Measures Installed
- Occupant Health and Health Care Coverage

### 5.1 CHARACTERIZATION OF STUDY PARTICIPANTS AND HOUSING UNITS

This section of the report presents statistics characterizing participants of this study and the homes in which they reside. The average (mean) number of occupants living within the study households (n= 49) was 4.6 people with 1.4 of those being children. The majority (48%) of children with asthma participating in the study was between the ages of 5-10 and 31% were between the ages of 0 to 5 years (See Table 5.1) with the mean age at 7.6 years (ranging from 2 to 17 years of age). Comparing age groups between program types revealed that the Healthy Homes Only group consisted of more than double the children between the ages of 5-10 than the other two groups. It was expected that the Opportunity Council study samples that focused on children with asthma would contain a higher percentage of younger children compared to the WAP groups that included adults of elderly or with disability status as high priority.

Many of the households (46%) self-identified as Non-Hispanic White; 15% identified as Hispanic White, 21% as Hispanic “Other” and 8% as Non-Hispanic “Other.” Very few households identified as Black, American Indian, Alaska Native, or Asian (Table 5.2).

**Table 5.1. Age Ranges of Children with Asthma in Study Households – by Program Type**

Age range		Program Type			
		Wx + Health	Wx Only	HH Only	All Groups Combined
<b>0-5</b>	Count	9	5	8	22
	% within Age range	42.9%	23.8%	27.6%	31.0%
<b>5-10</b>	Count	8	7	19	34
	% within Age range	38.1%	33.3%	65.5%	47.9%
<b>10-15</b>	Count	4	6	1	11
	% within Age range	19.0%	28.6%	3.4%	15.5%
<b>15-20</b>	Count	0	3	1	4
	% within Age range	0.0%	14.3%	3.4%	5.6%
<b>Total</b>	Count	21	21	29	71
	% within Age range	100.0%	100.0%	100.0%	100.0%

**Table 5.2. Household Ethnicity and Race – All Groups Combined**

Ethnicity		Race					
		White	Black or African-American	American Indian or Alaska Native	Asian	Other	Total
<b>Hispanic</b>	Count	7	0	0	0	10	17
	% within Ethnicity	41.2%	0.0%	0.0%	0.0%	58.8%	100.0%
	% within Race	24.1%	0.0%	0.0%	0.0%	71.4%	35.4%
	% of Total	<b>14.6%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>20.8%</b>	<b>35.4%</b>
<b>Non-Hispanic</b>	Count	22	2	1	2	4	31
	% within Ethnicity	71.0%	6.5%	3.2%	6.5%	12.9%	100.0%
	% within Race	75.9%	100.0%	100.0%	100.0%	28.6%	64.6%
	% of Total	<b>45.8%</b>	<b>4.2%</b>	<b>2.1%</b>	<b>4.2%</b>	<b>8.3%</b>	<b>64.6%</b>
<b>Total</b>	Count	29	2	1	2	14	48
	% within Ethnicity	60.4%	4.2%	2.1%	4.2%	29.2%	100.0%
	% within Race	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	<b>60.4%</b>	<b>4.2%</b>	<b>2.1%</b>	<b>4.2%</b>	<b>29.2%</b>	<b>100.0%</b>

The majority of homes receiving weatherization, either alone or in combination with a healthy homes intervention were single family (SF) detached buildings with a crawlspace (Table 5.3). The Weatherization Plus Health group consisted of 64% SF homes and 36% mobile homes, with the Weatherization Only group having a higher ratio of SF to mobile homes at 87% and 13% respectively. Of those within the Weatherization plus Health group, 86% lived in a home with a crawlspace and 23% had a



basement; with the Weatherization Only group at 73% and 20%, respectively.<sup>24</sup> These housing characteristics were then used to identify any statistically significant relationships between asthma morbidity and health care utilization.

**Table 5.3. Housing Type/Characteristics – by Group**

Housing Type	Wx + Health	Wx Only
<b>Single-family</b>	64%	87%
<b>w/ crawlspace</b>	86%	73%
<b>w/ basement</b>	23%	20%
<b>Mobile Home</b>	36%	13%

Residential status for the entire group was fairly evenly split as 49% of households reported renting their homes and 50% owning their home. However, upon characterizing each study group, more of the Healthy Homes Only group households reported being renters, and more of the Weatherization Only group households were homeowners (Table 5.4). It appears that the study homes, collectively, were somewhat evenly represented with regard to location (i.e., rural, city, suburb, town) with the most reported (37%) being in a rural location (Table 5.5).

**Table 5.4. Residence Status of Household – by Group**

Residence Status	Program Type			All Groups Combined
	Wx + Health	Wx Only	HH Only	
<b>Rent</b>	52%	30%	57%	47%
<b>Own</b>	48%	61%	43%	50%
<b>Neither</b>	0	9%	0	3%

**Table 5.5. Location of Household -All Groups Combined**

Location	Frequency	Percent
<b>Rural</b>	18	36.7
<b>City</b>	14	28.6
<b>Suburb</b>	10	20.4
<b>Town</b>	7	14.3

## 5.2 PRESENCE OF HOME-SOURCE EVIDENCE-BASED ASTHMA TRIGGERS

Avoiding allergens alongside other environmental control efforts have been shown to be effective at reducing asthma attacks and clinical improvement can be observed through elimination of just one environmental allergen (Kelly 2014). Weatherization addresses multiple evidence-based indoor environmental triggers (e.g., mold, cockroaches, mice, dust, and by-products of combustion from gas cooking stoves and portable unvented heaters). Weatherization helps minimize many of these IEQ issues through dust and moisture-reduction measures such as air sealing, the cleaning and replacement of air filters (including High Efficiency Particulate Air (HEPA) filters) on air supply lines, proper whole-house and localized ventilation, and clothes dryer venting. The provision of accessories, such as HEPA vacuums, allergy pillow and mattress covers, and non-toxic cleaners may be included in the scope of

<sup>24</sup> These answers are not mutually exclusive; some SF homes can have both a basement and a crawlspace, or neither.

work if combined with Healthy Homes services (i.e., Weatherization Plus Health) depending on the needs of the occupants. As discussed in Section 3, these services are typically determined through an energy audit and an asthma checklist for eligible households and may be dependent on availability of leveraged resources secured by the weatherization or Healthy Homes provider and the condition of the home.

Table 5.6 presents frequencies of evidence-based asthma triggers found within study homes pre- and post-intervention. All pre-intervention findings presented in this section (and throughout Section 5) were extracted from the following survey instruments<sup>25</sup> (See Appendix A and B): 1) U. S. Environmental Protection Agency's Asthma Checklist and 2) Opportunity Council's Pollution Source Survey; therefore, the pre-intervention results are provided for the Weatherization Plus Health and the Healthy Homes Only groups. The pre-intervention survey findings were based on observations of weatherization staff. All post-intervention findings presented in this section (and throughout Section 5) were extracted from the following survey instruments: 1) Opportunity Council's Walk-through Checklist - findings based on observations of weatherization staff as well and 2) a modified version of ORNL's Occupant Survey designed for the national evaluation of WAP. It should be noted that the findings from the Occupant Survey are self-reported by the occupant rather than based on observations of weatherization staff.

The occupant survey was administered post-intervention ranging from 3 months to 4.3 years with the average (mean) at 26 months. Reporting both sets of post-intervention data provides the opportunity to consider differing perspectives while reducing bias inherent in self-reported data collection due to potential inconsistencies resulting from misinterpretation of questions and response bias. Furthermore, the occupant is more familiar with their home, while an auditor may be equipped with building science expertise, but can only observe what is happening during their time at the residence. Therefore, both sets of post-intervention data are provided for all groups.

When occupants were asked if it seemed their child's asthma was worse around pets, more than half (65%) of the Weatherization Plus Health group replied in the affirmative, while only 15% of the Healthy Homes Only group responded the same (Table 5.6). However, it was observed that 43% of the Weatherization Plus Health group had indoor pets pre-intervention, but close to half reported post-intervention, that they either no longer had pets or the pets were no longer allowed indoors. There was negligible change post-intervention for the Healthy Homes Only group. Within the Weatherization Only homes, 60% were observed to have indoor pets post-intervention. It remains unknown as to what percentage of children in the sample had allergies to pet dander.

A low percent of respondents reported smoking cigarettes inside the home at any time within all study groups. Although, for the Healthy Homes Only group, post-intervention there was an observed increase (by 15%) in the presence of smoking (e.g., ashtrays, cigarette butts). Unexpectedly, because of the measures installed, there was an increase in evidence of pests inside the home post-intervention for all groups.

The presence of carpets in the living room decreased slightly (by 5%) post-intervention for the Healthy Homes Only group. The Healthy Homes measures package does not always include the replacement of carpet<sup>26</sup>; in addition, it may have been determined that it would be more beneficial for the carpet to be removed in the child's bedroom rather than the living room. In contrast, observed close to 30% of the

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<sup>25</sup> See Methodology (Section 4.1) for a detailed description of which data (both pre- and post-intervention) were collected by participating agencies as part of its typical program delivery and which data were collected specifically for the purposes of this study.

<sup>26</sup> The Healthy Homes package does not always include carpet replacement; there are two Healthy Homes packages, a "simple" and a "full". The full Healthy Homes package can include carpet removal. 35% of the Healthy Homes Only group and 100% of the Weatherization Plus Health group received the full package. For those in the Weatherization Plus Health group that were observed to have carpet in their home (either living room or bedrooms) pre-intervention (n=11), 36% no longer had carpet in their living room post-intervention and 64% no longer had carpet in their child's bedroom. As for the Healthy Homes Only group (n=6): 17% no longer had carpet in living room post-intervention and 67% no longer had carpet in bedroom post-intervention.

Weatherization Plus Health group had their carpets removed in the living room. There was an increase (7%) in the presence of throw rugs in the living room post-intervention indicating that throw rugs might have been traded out for full carpet in some instances.

It should be noted that the frequencies (#) provided in this table represent the number of households, not individual cases. Furthermore, unless noted, household sample sizes (n) for each group are as follows:

- Weatherization Plus Health (n=14)
- WAP Only (n= 15)<sup>27</sup>
- Healthy Homes Only (n= 20)
- Opportunity Council (OC) groups (n= 34)<sup>28</sup>

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<sup>27</sup> Weatherization Only groups were provided services by the three comparison WAP agencies in the region – Snohomish County, Housing Authority of Skagit County, and Community Action Council of Lewis, Mason, and Thurston Counties to collectively provide the comparison sample

<sup>28</sup> OC groups include the recipients of the OC programs (i.e. those that received Healthy Homes interventions; Weatherization Plus Health and Healthy Homes Only) and constitute the treatment sample.

**Table 5.6. Home-Source Evidence-Based Asthma Triggers Pre and Post-Intervention by all Groups<sup>29,30</sup>**

	Pre		Post (staff observed)		Post (self- reported)
	#	%	#	%	%
<b>EVIDENCE-BASED ASTHMA TRIGGERS</b>					
<b>Asthma Worse Around Pets (Yes)<sup>31</sup></b>					
<b>Wx + Health</b>	9	65%	-	-	-
<b>Wx Only</b>	-	-	-	-	-
<b>HH Only</b>	3	15%	-	-	-
<b>OC groups</b>	<b>13</b>	<b>38%</b>	-	-	-
<b>Have Indoor Pets (Yes)</b>					
<b>Wx + Health</b>	6	43%	4	29%	21%
<b>Wx Only</b>	-	-	9	60%	73%
<b>HH Only</b>	6	30%	7	35%	35%
<b>OC groups</b>	<b>12</b>	<b>35%</b>	<b>11</b>	<b>32%</b>	<b>29%</b>
<b>Cigarette Smoking Inside Home (anywhere, at any time)<sup>32</sup> (Yes)</b>					
<b>Wx + Health</b>	1	7%	1	7%	0%
<b>Wx Only</b>	-	-	1	7%	7%
<b>HH Only</b>	0	0%	3	15%	5%
<b>OC groups</b>	<b>1</b>	<b>3%</b>	<b>4</b>	<b>12%</b>	<b>3%</b>
<b>Evidence of Pest Infestation (cockroaches, rodents, and/or other insects) (Yes)</b>					
<b>Wx + Health</b>	2	14%	3	21%	29%
<b>Wx Only</b>	-	-	2	13%	27%
<b>HH Only</b>	0	0%	2	10%	35%
<b>OC groups</b>	<b>2</b>	<b>6%</b>	<b>5</b>	<b>15%</b>	<b>33%</b>
<b>Carpet in Living Room (Yes)</b>					
<b>Wx + Health</b>	11	79%	7	50%	-
<b>Wx Only</b>	-	-	7	47%	-
<b>HH Only</b>	17	85%	16	80%	-
<b>OC groups</b>	<b>28</b>	<b>82%</b>	<b>23</b>	<b>68%</b>	-
<b>Throw Rugs in Living Room (Yes)</b>					
<b>Wx + Health</b>	5	36%	6	43%	-
<b>Wx Only</b>	-	-	7	47%	-
<b>HH Only</b>	3	15%	4	20%	-
<b>OC groups</b>	<b>8</b>	<b>24%</b>	<b>10</b>	<b>29%</b>	-
<b>Carpet in Child's Bedroom (Yes)</b>					
<b>Wx + Health</b>	-	-	9	43%	-
<b>Wx Only</b>	-	-	20	87%	-
<b>HH Only</b>	-	-	24	80%	-
<b>OC groups</b>	-	-	<b>33</b>	65%	-

<sup>29</sup> The frequencies (#) provided in this section represent the number of households, not individual cases, which responded yes.

<sup>30</sup> Unless noted, household sample sizes for each group are as follows: Weatherization Plus Health (n=14); Weatherization Only (n= 15); Healthy Homes Only (n= 20); All Opportunity Council (OC) homes (n= 34).

<sup>31</sup> For this question, pre-data was not observed, weatherization staff asked occupant the question.

<sup>32</sup> For this question, pre-data was not observed, weatherization staff asked occupant the question.

### 5.2.1 Moisture and Mold

Mold allergies, associated with asthma and other respiratory symptoms, are 30-50% more prevalent in damp houses, especially in those with damp basements (Rutgers 2011). Research also indicates that early exposure (in infancy) to high mold counts, as measured by the Environmental Relative Moldiness Index (ERMI) test, increases the risk for developing asthma by 50% in late childhood (Reponen 2011). Findings presented in Table 5.7 suggest that for all three groups participating in this study, observations of moisture and mold issues substantially decreased post-intervention. A 20% decrease in observed moisture damage to walls and ceilings, and a 60% decrease in observed standing water in the Healthy Homes Only group, was reported. For the Weatherization Plus Health group, a 28% decrease in moisture damage was observed and a 7% decrease in observed standing water was reported. The Weatherization Only group had post-intervention findings comparable to the other two groups in these two categories. It is interesting to note the difference between the observed and the self-reported findings for presence of standing water.

The decrease of close to 60% in reported excessive humidity levels for both Opportunity Council groups is most likely connected to the substantial decrease of observable mold or mildew; 65% in the Weatherization Plus Health group and 35% in the Healthy Homes Only group. Again, it should be noted that the self-reported findings were higher than what was observed by the staff. However, variation in question format exists between data collection instruments. The question in the occupant survey reads: *“Have you seen mold in your home in the past 12 months?”* Depending on how much time had passed since the intervention this data could be seen as more of a pre-intervention result, and in fact are quite similar to the observed pre-intervention findings. With that said, if these percentages are considered to be a proxy for a pre-intervention finding for the Weatherization Only group, in comparison to the other groups, these homes, at baseline, had better dwelling quality with respect to mold and mildew issues.

**Table 5.7. Moisture Issues Pre and Post-Intervention by all Groups**

	Pre		Post (staff observed)		Post (self- reported)
	#	%	#	#	%
<b>Evidence of Damage From Moisture On Walls/Ceiling (Yes)</b>					
<b>Wx + Health</b>	5	36%	1	8%	-
<b>Wx Only</b>	-	-	1	7%	-
<b>HH Only</b>	6	30%	2	10%	-
<b>OC groups</b>	<b>11</b>	<b>32%</b>	<b>3</b>	<b>9%</b>	-
<b>Observed Standing Water (crawlspce, fish tanks, house plants, etc.) (Yes)</b>					33
<b>Wx + Health</b>	5	36%	4	29%	14%
<b>Wx Only</b>	-	-	4	27%	7%
<b>HH Only</b>	17	85%	5	25%	15%
<b>OC groups</b>	<b>22</b>	<b>65%</b>	<b>9</b>	<b>27%</b>	<b>15%</b>
<b>Excessive Humidity Levels (Yes)<sup>34</sup></b>					
<b>Wx + Health</b>	10	71%	1	7%	-
<b>Wx Only</b>	-	-	2	13%	-
<b>HH Only</b>	12	60%	0	0%	-
<b>OC groups</b>	<b>22</b>	<b>65%</b>	<b>1</b>	<b>3%</b>	-
<b>See or Smell Mold or Mildew (Yes)</b>					35
<b>Wx + Health</b>	11	79%	2	14%	79%
<b>Wx Only</b>	-	-	5	33%	13%
<b>HH Only</b>	10	50%	3	15%	60%
<b>OC groups</b>	<b>21</b>	<b>62%</b>	<b>5</b>	<b>15%</b>	<b>68%</b>

### 5.2.2 Chemicals and Cleaning Supplies

This subsection presents frequencies associated with chemicals and toxic cleaning supplies found within study homes. When occupants were asked if it seemed their child’s asthma was worse when exposed to chemical based cleaning supplies, chemical air fresheners, perfumes, scented candles or laundry products, or insecticides, more than half both the Weatherization Plus Health and Healthy Homes Only groups, at 64% and 65% respectively, responded in the affirmative.

Table 5.8 presents findings associated with the visibility of chemicals and cleaning supplies inside treatment homes post-intervention. The balance of this data suggests that Opportunity Council homes (presumably more so than the Weatherization Only group) has either been educated on the benefits of replacing toxic cleaners with more natural, asthma- symptom friendly alternatives and/or been provided non-toxic cleaners as part of the Healthy Homes services measures package; 30% more of the Weatherization Only group, compared to the Weatherization Plus Health group, reported chemical cleaning supplies within easy access, and 43% more of the Weatherization Plus Health households reported non-toxic cleaning supplies within the home.

<sup>33</sup> Percentages based on those that stated they sometimes, often, or always observed standing water in their home.

<sup>34</sup> Pre-survey question did not specify a room or define “excessive humidity”; post-survey question specifically referred to the laundry room and defined excessive humidity as >60% Relative Humidity.

<sup>35</sup> The question in the occupant survey was: *Have you seen mold in the past 12 months?* Depending on how much time had passed since the intervention this question could be more of a pre-intervention result.

**Table 5.8. Chemicals and Cleaning Supplies Post-Intervention by all Groups**

	Post (staff observed)		Post (self- reported)
	#	%	%
<b>Toxic Chemicals (Paints/Solvents) Within Easy Access (Visible)</b>			
<b>Wx + Health</b>	0	0%	7%
<b>Wx Only</b>	2	13%	0%
<b>HH Only</b>	3	15%	5%
<b>Chemical Cleaning Supplies Are Within Easy Access (Visible)</b>			
<b>Wx + Health</b>	4	29%	36%
<b>Wx Only</b>	9	60%	53%
<b>HH Only</b>	9	45%	45%
<b>Non-toxic Cleaning Supplies Are in the Home</b>			
<b>Wx + Health</b>	10	71%	71%
<b>Wx Only</b>	4	27%	73%
<b>HH Only</b>	11	55%	70%

### 5.3 ALLERGY REDUCTION MEASURES

As mentioned in Section 3, upon delivery of Healthy Homes services, either in concert with weatherization or on its own, a home could have received either a simple or full package of services. Both were tailored to the needs of the household and the occupant: the simple package was typically delivered through a one-time visit to the home and included a comprehensive education component and provision of a selection of allergy reduction accessories; the full package included interventions requiring contracted work (e.g., replacement of carpet with laminate or hard wood flooring and/or installation of whole house ventilation systems). Table 5.9 presents the number of homes that received which type of package per program type. All Weatherization Plus Health households in the sample received the full package of services as did 35% of the Healthy Homes Only group.

**Table 5.9. Number of Homes that Received Full or Simple Healthy Homes Packages, Per Program Type**

Program Type	Type of HH package			Total
	No HH	Simple	Full	
Wx + Health	0	0	14 (100%)	14
Wx Only	15 (100%)	0	0	15
HH Only	0	13 (65%)	7 (35%)	20
<b>Total</b>	15	13	21	49

Table 5.10 presents the percentages of asthma trigger reduction accessories observed in use or present within the home: 90% of the Healthy Homes group was observed to have a HEPA vacuum, allergy mattress covers, and allergy pillow covers in their home post-intervention; 71% of the Weatherization Plus Health homes were using allergy pillow covers and 43% were using allergy mattress covers post-intervention. only 64% owned a HEPA vacuum. One might have expected that the Weatherization Plus Health group and Healthy Homes Only group to have had comparable frequencies for these findings. However, the necessity of these services is determined through the EPA Asthma Checklist and may also be dependent on availability of leveraged resources; therefore, not all homes received the complete list of

services within its provided package. In addition, this data was based on observations of field staff; occupants may not have been utilizing the accessories at the time of the visit or have them in sight. It should also be considered that this program serves a population that might not be able to afford to continue with best practice.

Since these accessories are not considered a DOE allowable expense through traditional WAP it was hypothesized that their presence post-intervention would be at a much lower percentage for the homes in the Weatherization Only group, which is confirmed in the table below.

**Table 5.10. Presence of Asthma Trigger Reduction Measures Post-Intervention by all Groups**

	Post (staff observed)	
	#	%
<b>Own a HEPA Vacuum<sup>36</sup></b>		
<b>Wx + Health (n=14)</b>	9	64%
<b>Wx Only (n=15)</b>	3	20% <sup>37</sup>
<b>HH Only (n=20)</b>	18	90%
<b>OC groups (n=34)</b>	<b>27</b>	<b>79%</b>
<b>Allergy Covers on Mattress<sup>38</sup></b>		
<b>Wx + Health (n= 21)</b>	9	43%
<b>Wx Only (n= 23)</b>	5	22%
<b>HH Only (n= 30)</b>	27	90%
<b>OC groups (n=51)</b>	<b>36</b>	<b>71%</b>
<b>Allergy Covers on Pillows</b>		
<b>Wx + Health (n= 21)</b>	15	71%
<b>Wx Only (n= 23)</b>	3	13%
<b>HH Only (n= 30)</b>	27	90%
<b>OC groups (n=51)</b>	<b>42</b>	<b>82%</b>

### 5.3.1 Ventilation

There is growing concern within the public health and building science communities regarding emissions from unvented gas cooking stoves or the use of unvented combustion space heaters. As stated in Section 2, simulated models of the effects of building interventions and IEQ on pediatric asthma outcomes in low-income households suggest that weatherization<sup>39</sup> targeting the sealing of the building envelope led to an increase in pollutant concentration of NO<sub>2</sub> and PM<sub>2.5</sub>, and 20% more serious asthma events, but that bundling weatherization with repairing kitchen exhaust fans mitigated this adverse impact (Fabian et al. 2013). Range hoods can be installed and vented outdoors to provide localized ventilation in homes where this is logistically feasible. Results from the national occupant survey showed that post-weatherization, the number of program respondents that reported using a cook stove exhaust fan regularly increased by 8% (Tonn et al. 2014).

<sup>36</sup> Results for owning a HEPA vacuum are per household, as indicated by the n.

<sup>37</sup> The self-reported percentage was quite a bit higher here, at 53%. This could be due to a lack of understanding in how the agency defines a “HEPA” vacuum.

<sup>38</sup> Results for allergy covers on mattress and on pillows are on a “per case” (individual) basis rather than by household, as indicated by the n..

<sup>39</sup> The Fabian et al. (2013) study was not focusing on weatherization as delivered through WAP. Weatherization in this context is referring to energy-efficiency retrofits and building interventions in general.



Within this study, electric cooking stoves were more commonly observed to be in use both pre- and post-intervention; only 15% of the Weatherization Plus Health households, 20% of the Weatherization Only, and 25% of the Healthy Homes Only groups used gas cooking stoves (Table 5.11).<sup>40</sup> None of the study groups were found to be using any unvented gas appliances in the home, both pre and post-intervention. All groups that had heating units fueled by gas were properly vented to the outside.

**Table 5.11. Potential Sources of Indoor Environmental Contaminants Post-Intervention by all Groups**

	Post (staff observed)	
	#	%
<b>Use Gas For Cooking Fuel</b>		
<b>Wx + Health</b>	2	15%
<b>Wx Only</b>	3	20%
<b>HH Only</b>	5	25%
<b>Heating Unit Vents Outside (for households heated with gas)</b>		
<b>Wx + Health</b>	13	100%
<b>Wx Only</b>	12	100%
<b>HH Only</b>	7	100%

For this study, data was not collected at household level for the usage of kitchen or bathroom fans pre-intervention; therefore, we are unable to establish any increase in mechanical ventilation usage post-intervention. Specific data on kitchen and bathroom fan installation was not collected either. However, the two participating agencies reported the installation of “whole-house ventilation.” Whole house ventilation, as described by the Opportunity Council, refers to “the whole home receiving fresh outside air.” This can be achieved by installing fans (more often a centralized bath fan) and running them continuously or intermittently (on a timer, not easily turned off by the occupant) throughout the day. This type of ventilation exhausts indoor contaminants and humidity but also pulls outside air into the home (if the building envelope is not too tight). Supplying this outside air also has a drying effect; the often cool/moist outside air enters the home is warmed up and dehumidified (K. White, personal communication, April 2015).

The majority of homes within the Weatherization Plus Health and Weatherization Only groups received whole-house installation at 93% and 87%, respectively (Section 5.5 presents data on other weatherization and healthy homes measures installed for these homes). Findings reveal that 93% of both groups were observed to have a functional bathroom fan post-intervention; however only 64% of the Weatherization Plus Health and 53% of the Weatherization Only groups were observed to have a functional kitchen fan (Table 5.12). The Healthy Homes Only group in general was observed to have a lower percentage of functional mechanical ventilation measures post-intervention, at 80% (bathroom fans) and 50% (kitchen fans). Respondents report using their bathroom fans much more than their kitchen fans (for those that have them); with 100% of the Weatherization Plus Health and 100% of the Weatherization Only, and 75% of the Healthy Homes Only groups using their bathroom fan at least rarely if not every time. As low as 47% of the Weatherization Only group reports using their kitchen fan at least rarely whereas the Weatherization Plus Health households use their kitchen fan at least rarely 64% of the time.

<sup>40</sup> None of the study homes received a new stove as part of their intervention.

**Table 5.12. Presence of Functional and in Use Mechanical Ventilation Measures Post-Intervention**

<b>Group</b>	<b>Functional Kitchen Fan (Post)</b>	<b>Use kitchen fan (self-reported)<sup>41</sup></b>	<b>Functional Bathroom Fan (Post)</b>	<b>Use bathroom fan (self-reported)<sup>42</sup></b>
<b>Wx + Health</b>	64%	64%	93%	100%
<b>Wx Only</b>	47%	73%	93%	100%
<b>HH Only</b>	50%	60%	80%	75%

Natural ventilation can minimize energy use during the warmer months and can either aid in exhausting contaminated and/or humid indoor air to the outside, or supply contaminated and/or humid outdoor air to the indoor environment, depending on climate and several other contributing factors. Findings revealed that most, if not all, of the study households opened their windows in the summer at least rarely to all the time; 93% of the Weatherization Plus Health group and 100% of the Weatherization Only and Healthy Homes Only groups replied in the affirmative (Table 5.13). As for during the winter, close to 80% of the Weatherization Plus Health group reported opening windows, followed by the Healthy Homes Only group (70%), and slightly more than half of the Weatherization Only group.

**Table 5.13. Natural Ventilation Post-Intervention by all Groups**

	<b>Post (self-reported)</b>
<b>Open Windows At All in The Summer (Rarely, Sometimes, Frequently, All the time)</b>	
<b>Wx + Health</b>	93%
<b>Wx Only</b>	100%
<b>HH Only</b>	100%
<b>Open Windows At All in The Winter (Rarely, Sometimes, Frequently, All the time)</b>	
<b>Wx + Health</b>	79%
<b>Wx Only</b>	53%
<b>HH Only</b>	70%

## **5.4 IMPACTS OF WEATHERIZATION AND HEALTHY HOMES EDUCATION**

As part of Weatherization Plus Health and Healthy Homes Only program delivery, comprehensive education on asthma trigger reduction measures is provided. Decreasing the use of toxic chemicals and cleaners within the home and increasing dust reduction behaviors are topics typically discussed. As presented in Table 5.14 there was a substantial decrease pre- to post-intervention in the use of chemical-based cleaning supplies (compared to more asthma-friendly, non-toxic alternatives) “all or most of the time.” However, it appears that the Weatherization Plus Health group experienced more of a change as their use of chemicals “all or most of the time” dropped 72%; 20% for the Weatherization Only and 60% for the Healthy Homes Only group. It should be noted that these topics are not typically covered during traditional WAP delivery (Weatherization Only).

<sup>41</sup> Rarely, Sometimes, Often, or Every time

<sup>42</sup> Rarely, Sometimes, Often, or Every time

**Table 5.14. Comparison of Use of Chemical Cleaning Supplies Pre to Post-Intervention by All Groups**

Use More Chemical Based Cleaning Supplies (compared to more asthma-friendly, non-toxic alternatives)	Pre			Post		
	All or most of the time	Some or a little of the time	Never	All or most of the time	Some or a little of the time	Never
<b>Wx + Health</b>	79%	14%	7%	7%	86%	7%
<b>Wx Only</b>	40%	53%	7%	20%	67%	13%
<b>HH Only</b>	75%	25%	0%	15%	75%	10%

Results from the national WAP evaluation occupant survey revealed that treatment homes reported changing their air filters more often post-weatherization (Tonn et al. 2015). The benefits of changing the air filter on the furnace are two-fold; it can both reduce energy use and improve IEQ. Table 5.15 presents that 50% of Weatherization Plus Health, 47% of Weatherization Only, and 25% of Healthy Homes Only households were observed to have changed their furnace filter in the last six months. However, the frequency of this action was challenging to quantify simply from observing the “cleanliness” of the filter from one house to the next. The self-reported frequencies provide an alternative perspective; 54% of the Weatherization Plus Health, 33% of Weatherization Only, and 52% of Healthy Homes Only households reported changing their furnace filter at least every 6 months. However, 10% more of the Weatherization Only group (compared to the Healthy Homes Only group) and 16% more of the Weatherization Only group (compared to the Weatherization Plus Health) group reported using a service company that changes the air filter.

**Table 5.15. Frequency of Changing/Cleaning Furnace Filter Post-Intervention by All Groups**

Change/Clean Air Filter on Furnace (within last six months) <sup>43</sup>	Post		Post (self-reported)
	Frequency	%	%
<b>Wx + Health</b>	7	50%	54%
<b>Wx Only</b>	7	47%	33%
<b>HH Only</b>	5	25%	52%

It appears that the Opportunity Council homes, collectively, displayed evidence of being “dusted” on a weekly basis (50%); slightly more than the Weatherization Only homes (40%) (Table 5.16). Additionally, the Opportunity Council homes, again collectively, reported cleaning and vacuuming more often since receiving intervention substantially more than the Weatherization Only group at 91% and 13%, respectively. These findings support the argument that comprehensive education provided through Healthy Homes programs empowers households with knowledge of methods to minimize home-source evidence-based asthma triggers.

<sup>43</sup> Based on observed evidence of changing/cleaning air filter on heating system within the last 6 months.

**Table 5.16. Frequency of Dusting/Cleaning and Vacuuming Post-Intervention by All Groups**

Evidence of Weekly Dusting	Post (observed)	
	Frequency	%
<b>Wx + Health</b>	7	50%
<b>Wx Only</b>	6	40%
<b>HH Only</b>	10	50%
<b>OC groups</b>	17	50%
<b>Clean and vacuum more often since receiving intervention (all of the time, most of the time, some of the time, a little of the time).</b>		
	Yes (self-reported)	
<b>Wx + Health</b>	93%	
<b>Wx Only</b>	13%	
<b>HH Only</b>	90%	
<b>OC groups</b>	91%	

## 5.5 WEATHERIZATION AND HEALTHY HOMES MEASURES INSTALLED

Air sealing and insulation measures are commonly installed weatherization measures that not only save energy but reduce exposure to extreme hot and cold temperatures and reduce infiltration of pests, dust and outdoor contaminants, thereby reducing exposure to evidence-based asthma triggers. Mechanical ventilation measures address moisture related problems in the home and may exhaust contaminants generated from the indoor environment or those that have infiltrated the home from the outdoor environment.

Table 5.17 presents results from the national WAP evaluation with respect to measures installed in homes (all building types) weatherized in PY 2010 for a subset of homes located within the climate region applicable to Northwestern Washington referred to as the ‘moderate’ climate region.<sup>44</sup> Installation rates were as follows: 100% received some type of insulation (i.e. attic, floor or wall); 90% air sealing; 41% duct-sealing; 65% a new heating system (as an energy cost measure (ECM)); 28% a new heating system (not for energy conservation purposes); 19% received any window measure; 11% a new air conditioner (AC); and 17% received ventilation measures (i.e. whole-house, kitchen or bathroom fan). Based on blower door tests conducted both pre- and post-weatherization, the mean air leakage reduction was 970 cubic feet per minute (CFMs).

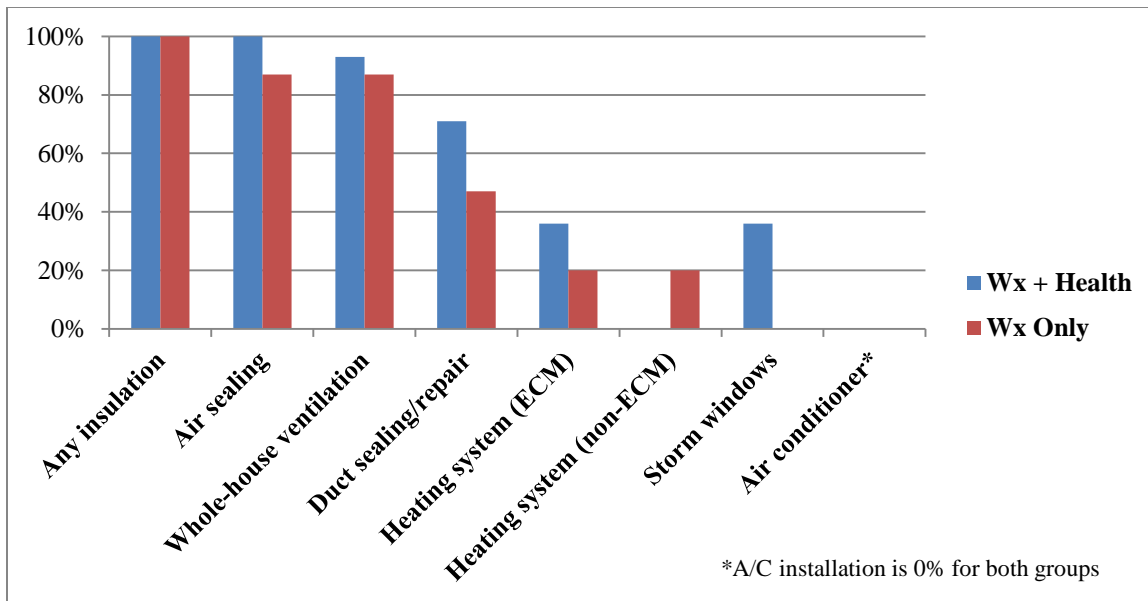
<sup>44</sup> As part of the national evaluation five climate regions were defined, which were based in large part on the climate zones recognized by DOE’s Building America program except that states are uniquely assigned to a single zone. Each state was assigned to a climate region based on estimates of the heating and cooling degree days for the major population centers (Bensch et al. 2014). All homes for this special study were located in Northwestern Washington State; the moderate climate zone.

**Table 5.17. Weatherization Measures Installed In Moderate Climate Region for National Sample**

<b>Weatherization Measure</b>	<b>Moderate Climate Region</b>
<b>Any Insulation</b>	100%
<b>Air Sealing</b>	90%
<b>Duct Sealing</b>	41%
<b>Heating Equipment</b>	
<b>New Heating System</b>	28%
<b>New Heating System (ECM)</b>	65%
<b>Any Window Measure</b>	19%
<b>Ventilation (Whole House, Kitchen, Bath Fan)</b>	17%
<b>Air Conditioning</b>	11%
<b>Air Leakage</b>	
<b>Pre</b>	3360 CFM
<b>Post</b>	2390 CFM

Comparing the rates presented in Table 5.17 with Figure 5.1, measure installations rates between the national moderate climate region sample and the Weatherization Only group are similar for insulation installation, air and duct sealing, and heating system replacement (non-ECM only); but not for ventilation measures, heating system replacement (ECM), and AC replacement. The ventilation (whole-house) installation rate for this group is 70% higher than the national sample and 45% lower for ECM heating system replacements. None received AC replacements.

As for the Weatherization Plus Health homes, insulation and air sealing was installed 100% of the time, and ventilation measure installation was 23% higher even than the Weatherization Only study homes. None of those homes received a new AC either. In comparison to the national sample, duct sealing (71%) and window (storm) installation (36%) were more frequent for the Weatherization Plus Health group. None of the Weatherization Plus Health homes received a non-ECM furnace replacement.



**Figure 5.1: Weatherization and Healthy Homes Measures Installed by Group: Weatherization Plus Health and Weatherization Only**

As mentioned above, the level of draftiness can indicate how well sealed a home is; the lower the air leakage rate (CFMs), the tighter the building envelope is and the less likely pests and outdoor contaminants can enter the home. Table 5.18 presents the pre and post-intervention CFMs for both the Weatherization Plus Health and Weatherization Only homes. Pre-intervention, both groups’ homes were already tighter than the national sample, providing explanation for the mean reduction being less (~150-300 CFMs). For the study groups in the sample, pre-intervention, the Weatherization Only homes were more leaky in comparison to the Weatherization Plus Health homes, but the Weatherization Plus Health homes post-intervention were more tightly sealed (1407 CFMs) than the Weatherization Only homes (1,588 CFMs). A balanced approach is required to mitigate the infiltration rate of outdoor generated air contaminants while not sealing in the indoor sourced contaminants. This is where whole-house mechanical ventilation becomes a critical component for addressing IEQ in concert with weatherization.

**Table 5.18. House Air Leakage Rate Pre and Post-Intervention by Group: Weatherization Plus Health and Weatherization Only (mean CFMs)**

Group	Pre-Intervention	Post-Intervention	Reduction (mean CFMs)
<b>Wx + Health</b>	2067	1407	660
<b>Wx Only</b>	2409	1588	821

### 5.5.1 Indoor Temperatures

Existing research studies show that exposure to extreme temperatures can exacerbate asthma symptoms in turn increasing ED admissions for childhood asthma (Xu et al. 2013 and Guo et al. 2012). Xu (2013) states “children aged 0-4 years were more vulnerable to heat effects while children ages 10-14 years were more vulnerable to cold effects.” Findings from this study suggest that post-intervention indoor temperatures were dramatically more comfortable for the occupants. Table 5.19 presents that 97% of the Weatherization Plus Health households reported pre-intervention that their home was either “cold” or “very cold”; post-intervention 100% reported their home was “comfortable.” The increase in comfortable

temperatures for Weatherization Only and Healthy Homes Only<sup>45</sup> group households were also observed, but it appears that there might be potential for synergistic benefits of WAP plus healthy housing evident based on these results.

**Table 5.19. Indoor Temperatures Pre and Post-Intervention by All Groups**

<b>Indoor Temperatures</b>					
<b>Pre</b>					
	<b>Very Cold</b>	<b>Cold</b>	<b>Comfortable</b>	<b>Hot</b>	<b>Very Hot</b>
<b>Wx + Health</b>	77%	23%	-	-	-
<b>Wx Only</b>	60%	40%	-	-	-
<b>HH Only</b>	40%	40%	20%	-	-
<b>OC groups</b>	<b>61%</b>	<b>30%</b>	<b>9%</b>	-	-
<b>Post</b>					
	<b>Very Cold</b>	<b>Cold</b>	<b>Comfortable</b>	<b>Hot</b>	<b>Very Hot</b>
<b>Wx + Health</b>	-	-	100%	-	-
<b>Wx Only</b>	13%	-	87%	-	-
<b>HH Only</b>	-	10%	80%	10%	-
<b>OC groups</b>	-	<b>4%</b>	<b>91%</b>	<b>4%</b>	-

## 5.6 OCCUPANT HEALTH AND HEALTH CARE COVERAGE

As stated previously, social justice in the context of human health is generally equated with access to health resources and equal opportunity to a healthy life. Fortunately, the majority of children that participated in this study were reported by the head of household to have had health care coverage (at least over the 12 months prior to the post-intervention occupant survey), with more of the Opportunity Council groups (91% collectively) than the Weatherization Only group (64%) holding Medicaid as their primary insurance (See Table 5.20).

**Table 5.20. Health care Coverage Post-Intervention - All Groups**

<b>HEALTH CARE COVERAGE</b>	<b>Wx + HH</b>	<b>Wx Only</b>	<b>HH Only</b>	<b>OC Groups</b>
<b>In the past 12 months has your child(ren) with asthma had any kind of health care coverage?</b>				
<b>Yes</b>	100%	87%	95%	97%
<b>If yes, which type?</b>				
<b>Medicaid</b>	93%	64%	95%	91%
<b>Basic Health<sup>46</sup></b>	-	21%	-	-
<b>Private individual or group insurance</b>	7%	7%	5%	6%

The next set of tables present data reported by the head of the household for all study groups related to health status post-intervention (i.e., frequency of asthma symptoms, ED and hospital visits, and days of

<sup>45</sup> The increased rate of reported comfort for the Healthy Homes Only group is debatable as they did not receive any weatherization measures. One explanation for the reported increase in comfort could be due to response bias.

<sup>46</sup> Washington Basic Health (WBH) is a system created and administered by the state of Washington to enable low income individuals, and families to purchase basic health care services through participating managed health care plans. WBH is administered by the Health Care Authority, available to Washington residents who meet income guidelines and are not eligible for Medicare. Premiums are based on age and income. Washington Basic Health Plus (WBHP) is a Medicaid Program administered by the Department of Social and Health Services and the Health Care Authority for children from low-income families. There are no premiums or copayments. It should be noted that these surveys were administered before the Affordable Care Act and these programs may currently differ from the description above.

school missed.) Table 5.21 focuses on head of household health status post-intervention and Table 5.22 focuses on child health status post-intervention.

All children participating in this study were reported by the head of the household to have asthma;<sup>47</sup> although not all had received a medical diagnosis. Within the sample, 93% of the Weatherization Plus Health group, 80% of the Weatherization Only group, and 95% of the Healthy Homes Only group contained at least one child with an asthma diagnosis from a medical provider. Interestingly, 8% of the Weatherization Plus Health group, 11% of the Healthy Homes Only group, and 18% of the Weatherization Only group reported that post-intervention at least one child in the home *no longer had asthma*.

A comparison between groups showed that individuals within the Weatherization Only group (for both head of household and child) experienced asthma symptoms much more recently (“within the last six days”) than the Opportunity Council groups, collectively, and in particular the Weatherization Plus Health group. The Weatherization Only and Healthy Homes Only group included individuals that reported they sought out urgent health care over the last 12 months due to asthma symptoms where individuals from the Weatherization Plus Health group reported they did not. One adult and one child in the Healthy Homes Only group and one child in the Weatherization only group reported to have stayed overnight in a hospital. One child within the Weatherization only group and four children within the Healthy Homes only group were reported to have gone to the ED (not counting hospitalizations) for their asthma symptoms.

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<sup>47</sup> It is important to note that even though all children participating in this study were reported to have asthma by the head of the household that the findings in this table specifically were from the occupant survey which was administered at the household level. Questions pertaining to symptoms, diagnoses, medical care, days of school missed can only be related to one child in the home, regardless of the number of children living in the home. Therefore the sample sizes are not the total number of children included in each group. Medical data on a case by case basis will be explored in Section 6 through the analysis of Medicaid and Physician records.



**Table 5.21. Health Status (Head of Household) Post-Intervention - All Groups\***

<b>HEAD OF HOUSEHOLD HEALTH STATUS POST-INTERVENTION</b>	<b>Wx + HH</b>	<b>Wx Only</b>	<b>HH Only</b>	<b>OC Groups</b>
<b>Have you ever been told by a doctor or other health professional that YOU (head of household) have asthma?</b>	<b>n=14</b>	<b>n=15</b>	<b>n=20</b>	<b>n=34</b>
<b>Yes</b>	36%	27%	35%	35%
<b>Do you STILL have asthma?</b>	<b>n=5</b>	<b>n=4</b>	<b>n=9</b>	<b>n=14</b>
<b>No</b>	20%	25%	56%	57%
<b>How long has it been since YOU last had any symptoms of asthma?<sup>48</sup></b>	<b>n=5</b>	<b>n=3<sup>49</sup></b>	<b>n=5<sup>50</sup></b>	<b>n=10</b>
<b>Less than one day ago</b>	-	33%	20%	10%
<b>1-6 days ago</b>	20%	33%	20%	20%
<b>1 week to less than 3 months ago</b>	40%	-	-	20%
<b>3 months to less than 1 year ago</b>	20%	-	40%	30%
<b>1 year to less than 3 years ago</b>	-	-	-	
<b>3 years to 5 years ago</b>	-	33%	-	
<b>More than 5 years ago</b>	20%	-	-	10%
<b>During the past 12 months did YOU have to stay overnight in the hospital because of asthma?</b>				
<b>Yes</b>	0%	0%	20%	10%
<b>Not counting hospitalizations, during the past 12 months, did YOU go to an emergency room because of asthma?</b>				
<b>Yes</b>	0%	0%	0%	0%

\*Sample sizes are as follows (unless noted): Wx + Health = 5; Wx Only = 4; HH Only = 5; All OC Groups = 10

Table 5.22 also presents the number of days of school (including pre-school or daycare) that the head of household reported their children having to miss due to asthma symptoms. A substantial number of children, in all study groups, missed several days of school over the last 12 months due to asthma; 38% of the children within the Weatherization Plus Health group, and 58% of the Healthy Homes Only group missed 6+ days and 25% of the Weatherization Only group missed 11+ days of school.

Overall, a substantial number of caregivers reported that their child’s health had improved, in general, post-intervention. All of both the Opportunity Council groups and 82% of the Weatherization Only group reported their children “seemed to feel better”; and 100% of the Weatherization Plus Health group, 94% of the Healthy Homes Only group and 64% of the Weatherization Only group reported their children “could run and play longer” post-intervention.

<sup>48</sup> Missing answers include “Don’t know/not sure”.

<sup>49</sup> Sample size differed due to some respondents leaving question blank.

<sup>50</sup> Sample size differed due to some respondents leaving question blank.

**Table 5.22. Health Status (Child) Post-Intervention - All Groups\***

<b>CHILD HEALTH STATUS POST-INTERVENTION</b>	<b>Wx + HH</b>	<b>Wx Only</b>	<b>HH Only</b>	<b>OC Groups</b>
<b>Have you ever been told by a doctor or other health professional that at least one child in the home has asthma?</b>	<b>n=14</b>	<b>n=15</b>	<b>n=20</b>	<b>n=34</b>
<b>Yes</b>	93%	80%	95%	94%
<b>Does this child STILL have asthma?</b>				
<b>No</b>				
<b>How long has it been since your child(ren) last had any symptoms of asthma? (at least one child in the home)</b>				
<b>Less than one day ago</b>	-	20%	20%	12%
<b>1-6 days ago</b>	-	7%	20%	12%
<b>1 week to less than 3 months ago</b>	21%	13%	20%	21%
<b>3 months to less than 1 year ago</b>	50%	27%	15%	29%
<b>1 year to less than 3 years ago</b>	14%	7%	10%	12%
<b>During the past 12 months did your child(ren) have to stay overnight in the hospital because of asthma?</b>				
<b>Yes</b>	0%	9% (1)	6% (1)	3%
<b>Not counting hospitalizations, during the past 12 months, did your child(ren) go to an emergency room because of asthma?</b>				
<b>Yes</b>	0%	9% (1)	24% (4)	14%
<b>In the past 12 months, about how many days of school (including pre-school or daycare) has your child(ren) missed because of asthma-related symptoms?</b>	<b>n=14</b>	<b>n=15</b>	<b>n=20</b>	<b>n=34</b>
<b>0</b>	0%	0%	5%	5%
<b>1-5</b>	63%	75%	33%	45%
<b>6-10</b>	25%	0%	50%	40%
<b>11+</b>	13%	25%	8%	10%
<b>Does your child seem to feel better more of the time since your homes received weatherization and/or healthy homes services?</b>				
<b>Yes</b>	100%	82%	100%	100%
<b>Since receiving weatherization and/or healthy homes services is your child able to run and play longer without resting?</b>				
<b>Yes</b>	100%	64%	94%	97%

\*Sample sizes are as follows (unless noted): Wx + Health = 12; Wx Only = 11; HH Only = 17; All OC Groups = 29

In addition to suffering with asthma, for children living within the Opportunity Council homes, collectively, 44-62% had been diagnosed by a medical professional (sometime over the last 12 months) with respiratory allergies, the flu, persistent cold symptoms, and/or a sinus infection (Table 5.23). These rates are substantially lower among the children living within the Weatherization Only homes.

**Table 5.23. Other Health Issues (Child) Post-Intervention - All Groups**

<b>CHILD HEALTH STATUS POST-INTERVENTION</b>	<b>Wx + HH</b>	<b>Wx Only</b>	<b>HH Only</b>	<b>OC Groups</b>
<b>In the past 3 months, has your child(ren) had . . .</b>				
<b>Shortness of breath when lying down, waking up, or with light work or light exercise?</b>	<b>n=14</b>	<b>n=15</b>	<b>n=20</b>	<b>n=34</b>
<b>Yes</b>	43%	13%	35%	38%
<b>In the past 12 months has your child(ren) had or been told by a doctor or health professional that they have...( % of yes answers are reported only)</b>	<b>n=14</b>	<b>n=15</b>	<b>n=20</b>	<b>n=34</b>
<b>3 or more ear infections per year</b>	7%	7%	20%	15%
<b>Any kind of respiratory allergy</b>	50%	33%	65%	59%
<b>Flu</b>	57%	20%	55%	56%
<b>Persistent cold symptoms lasting more than 14 days</b>	57%	13%	65%	62%
<b>Sinus infection</b>	57%	13%	35%	44%
<b>Bronchitis</b>	21%	20%	25%	24%



## 6. ANALYSIS OF MEDICAID RECORDS

Medicaid records collected from the Washington State HCA<sup>51</sup> were sent to the Opportunity Council study staff to be de-identified prior to being sent to ORNL analysts. Case identifiers were used to link the records to demographics, housing characteristics, program type, and measures installed in the home collected through other study instruments. Analysis was completed on individual cases, instead of focusing on the household level, to better capture potential change in health status evidenced by changes in health care use and costs. Statistical analyses were performed using both Microsoft Excel and Statistical Package for the Social Sciences (SPSS) calculation functions.

### 6.1 CHARACTERIZATION OF MEDICAID STUDY DATA AND PARTICIPANTS

The HCA Medicaid file for this study contained 46 individual cases; 62.2% of the total study sample (Table 6.1). The file contained both *header* and *line* (i.e., “paid”) claims. Header claims contained a subset of line claims submitted for that date. For this study, line claims were used for calculating the total Medicaid claims and costs for pharmacy and professional claims under each header claim. Paid amounts for inpatient claims were pulled from the header claims as the costs for this type of claim were not found in the line claim field. The file received from HCA did not capture the costs for outpatient claims.<sup>52</sup> Claims were then sorted by program type; Weatherization Plus Health (Wx+H), WAP (Wx Only), and Healthy Homes only (HH Only). Intervention dates were inserted according to program service delivery dates provided by the participating agencies to eventually determine impacts on health status from changes in the home environment. The intervention date ranged between March 2006 and June 2013. Cases were included in the Medicaid analysis if adequate time for accrual of pre-intervention claims was observed (i.e., >3 months). Table 26 contains additional descriptive statistics on the HCA data set received, as well as for the 31.3% of the study’s cases deemed usable for this analysis (n=23). The Weatherization Plus Health group provided 43.5% of the usable Medicaid data with Weatherization Only and Healthy Homes Only groups contributing 26.1% and 30.4% respectively. On average (i.e., arithmetic mean), cases included in the Medicaid analysis contained a total of 25.1 line claims, and an average of 11.2 claims pre-intervention, 12.6 claims post-intervention, 12.3 months pre-intervention, and 28.3 months post-intervention. Study analysts used this data to calculate the difference in mean number of claims and costs per month pre and post-intervention between study groups (Section 6.2).

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<sup>51</sup> <http://www.hca.wa.gov/Pages/about.aspx>

<sup>52</sup> All outpatients claims received were \$0 claims at both the header and line levels. It is not well understood who paid for those outpatient claims.

**Table 6.1. Medicaid Data Collected by Research Group**

Medicaid data collected by Research Group (Individual Case Level)	Wx + HH	Wx Only	HH Only	ALL
<b>Whole sample</b>	n=21	n=23	n=30	n=74
<b>Medicaid data collected (cases)</b>	n=14	n=11	n=21	n=46
<b>% of program sample</b>	66.6%	47.8%	70%	62.2%
<b>Total number of line claims</b>	507	206	213	926
<b>Cases with usable Medicaid</b>	<b>n=10</b>	<b>n=6</b>	<b>n=7</b>	<b>n=23</b>
<b>% of Study sample</b>	47.6%	26.1%	23.3%	31.1%
<b>% of Medicaid sample</b>	43.5%	26.1%	30.4%	100%
<b>Total line claims per usable case (mean)</b>	25.1	31.3	46.6	33.3
<b>Line claims per case pre-intervention (mean)</b>	11.2	13.3	17.9	13.8
<b>Line claims per case post-interventions (mean)</b>	12.6	16.2	26.4	17.5
<b>Months per case pre-intervention (mean)</b>	12.3	9.5	11.3	11.3
<b>Months per case post-interventions (mean)</b>	28.3	25.2	18.7	24.6
<b>Claims within the 30 day post-window (mean)</b>	1.9	1.7	1.8	2.3

Within the Medicaid sample were two groups that received some extent of Healthy Homes measures; 73.9% of the total Medicaid sample. Those households that received either full or simple measure packages may have also received weatherization (i.e., Weatherization Plus Health). All Weatherization Plus Health recipients received the full extent of the Healthy Homes package in concert with their comprehensive weatherization package. Within the Medicaid Healthy Homes Only sample, 4 of the 7 cases received a one-time visit at the home and a simple measures package (e.g., public health education, HEPA vacuum, dust mite covers) with 3 having received a full package of Healthy Homes measures (e.g., carpet replacement with vinyl flooring) (Table 6.2). This distinction becomes relevant when considering impacts on Medicaid claims and costs and after identifying super-utilizers of the health care system within the Healthy Homes Only sample that might have benefitted from a more extensive home retrofit provided through Weatherization Plus Health.

**Table 6.2. Percent of Healthy Homes Cases That Received Either Full Or Simple Packages**

Healthy Homes package type	Full	Simple	ALL HH Cases
<b>Medicaid study participants</b>	n=13	n=4	n=17
<b>% of Medicaid sample</b>	76.5%	23.5%	100.0%

Table 6.3 contains caregiver-reported demographics and housing characteristics for the participants in the sample for each study group. Overall, 56.5% of the sample was male, 30.4% was white/non-Hispanic, 21.7% identified as white/Hispanic, and 26.1% identified as Hispanic. Black, non-Hispanic, Asian and those reported as “Other” were underrepresented at 4.3%, 8.7% and 8.7% respectively. Unfortunately, no individuals in the sample identified as American Indian. According to Washington State level statistics, this population is disproportionality burdened with widespread asthma prevalence (CDC 2015).

Over half of the study sample contained children aged 5-10 years of age. This was expected as the programs operated through the Opportunity Council target families with young children with asthma. The majority of households in the sample rented their home, with the exception of those in the Weatherization Only group who reported being homeowners (66.7%). Differences between groups were observed when housing type was assessed. The vast majority of households in the Weatherization Plus Health group resided in manufactured housing while over half of the households in the Healthy Homes group and 100% of households in the Weatherization Only group resided in SF site built housing.

**Table 6.3. Caregiver-Reported Demographics and Housing Characteristics by Study Group**

Survey Questions from Occupant Survey (Self-Reported Post-Intervention as part of the study)	Wx + HH	Wx Only	HH Only	ALL
<b>DEMOGRAPHICS</b>	n=10	n=6	n=7	n=23
<b>Gender</b>				
Male	60%	50%	57.4%	56.5%
Female	40%	50%	42.9%	43.5%
<b>Race</b>				
White, Non-Hispanic	10%	66.7%	28.6%	30.4%
White, Hispanic	40%	16.7%	-	21.7%
Hispanic	40%	-	28.6%	26.1%
Black, Non-Hispanic	-	-	14.3%	4.3%
Asian	10%	-	14.3%	8.7%
Other	-	16.7%	14.3%	8.7%
<b>Age range (years)</b>				
0-5	40%	33.3%	14.3%	30.4%
5-10	50%	16.7%	85.7%	52.2%
10-15	10%	16.7%	-	8.7%
15-20	-	33.3%	-	8.7%
<b>HOUSING</b>				
<b>Home occupancy type</b>				
Rent	80%	16.7%	71.4%	60.9%
Own	20%	66.7%	28.6%	34.8%
Neither	-	16.7%	-	4.3%
<b>Housing Type</b>				
Apartment	-	-	14.3%	
Manufactured	60%	-	14.3%	
Single family	40%	100%	57.1%	
Other	-	-	14.3%	

International Classification of Diseases, Ninth Revision (ICD-9) codes were used for the HCA request for records. All header or line claims with any ICD-9 asthma codes (codes starting with 493) listed as either primary or secondary diagnosis were requested. Table 6.4 contains the ICD-9 codes listed as the primary diagnosis for each line claim in the HCA Medicaid data set received.<sup>53</sup>

<sup>53</sup> Additional diagnosis codes were observed but were not included in this list if deemed non-relatable to the study.

**Table 6.4. ICD-9 Codes Listed As Primary Diagnosis for Line Claims**

<b>ICD-9<sup>54</sup> Diagnosis codes for all line claims (n=926)</b>	
Primary Diagnosis is Asthma – ICD-9 code starting with 493.	
493.00	Extrinsic asthma, unspecified
493.01	Extrinsic asthma with status asthmaticus
493.02	Extrinsic asthma with (acute) exacerbation
493.10	Intrinsic asthma, unspecified
493.12	Intrinsic asthma with (acute) exacerbation
493.81	Exercise induced bronchospasm
493.82	Cough variant asthma
493.90	Asthma, unspecified type
493.91	Asthma, unspecified type with status asthmaticus
493.92	Asthma, unspecified type with (acute) exacerbation
Other Primary Diagnosis with a 493 asthma diagnosis code as secondary diagnosis	
786.2	Cough
472.0	Chronic rhinitis
474.10	Hypertrophy of tonsil with adenoids
465.9	Acute upper respiratory infections of unspecified site
462	Acute pharyngitis
786.07	Wheezing
461.0	Acute maxillary sinusitis
799.9	Other unknown and unspecified cause of morbidity and mortality
382.9	Unspecified otitis media
486	Pneumonia, organism unspecified
381.10	Chronic serous otitis media, simple or unspecified
530.81	Esophageal reflux
461.9	Acute sinusitis, unspecified
381.00	Acute nonsuppurative otitis media, unspecified
786.50	Unspecified chest pain
477.8	Allergic rhinitis due to other allergen
995.20	Unspecified adverse effect of unspecified drug, medicinal and biological substance
477.0	Allergic rhinitis due to pollen
466.0	Acute bronchitis
477.9	Allergic rhinitis, cause unspecified
784.0	Headache

Both header and line claims were categorized by claim type for further characterization and analysis of costs (Table 6.5). The total amount of claims received from HCA was approximately \$70.5K. Inpatient costs account for 19.7% of the total amount paid by Medicaid for all claims received from HCA. The Medicaid paid amount without inpatient claims totaled \$56,655. The average cost per claim without

<sup>54</sup> ICD-9 code listings were retrieved from; <http://www.cms.gov/medicare-coverage-database/staticpages/icd-9-code-lookup.aspx?Keyword=784&bc=AAAAAAAAAAEAA%3d%3d&>



inpatient costs was approximately \$61 per claim.<sup>55</sup> Table 6.6 contains types of Medicaid claims for each of the study groups. The Weatherization plus Health group comprised the least amount of claim totals at approximately \$17K.

**Table 6.5. Header and Line Claim Types**

Type and cost of Asthma-related Medicaid Line Claims for all Cases (n=46)	Inpatient	Outpatient	Pharmacy	Professional	ALL
Count	n=3	n=11	n=387	n=525	n=926
Cost	\$13,877	NA	\$32,410	\$24,266	\$70,552
% of total costs	19.7%	NA	45.9%	34.4%	100%

**Table 6.6. Header and Line Claim Types by Research Group**

Cost of Asthma-related Medicaid Line Claims for all Cases (n=46) by program type	Wx + Health	Wx Only	HH Only	Total Costs
Inpatient claims	-	\$10,564	\$3,313	\$13,877
Pharmacy claims	\$6,266	\$10,318	\$15,826	\$32,410
Professional claims	\$10,707	\$5,098	\$8460	\$24,266
<b>All claims</b>	<b>\$16,973</b>	<b>\$25,980</b>	<b>\$27,599</b>	<b>\$70,552</b>

Similar to how the CMCS categorized recipients of Medicaid as super-utilizers of the health care system, the Medicaid cases and claims submitted by the HCA were combed for indicators that might contribute to this discussion. Of the 926 claims collected, 6 individual cases contributed to 40% of all claims received (n=401). Included in the data set were three claims for inpatient hospital care for three separate cases totaling \$13,877; approximately 20% of the total cost for all claims. The inpatient claim submitted by one individual in the HH group was prior to the intervention. The two claims submitted by the Weatherization Only group were submitted post intervention. In this sample, individual cases were categorized as super-utilizers of the Medicaid system if they were included in the pre/post costs comparisons *and* if they had received inpatient hospital care with a primary asthma-related diagnosis, *or* their annualized costs for asthma were greater than the pre-intervention mean (\$1,129) for that sample. The eight (17.4% of the sample) cases that qualified for this group accounted for 54% of the total claims and 45.7% of the total costs of all claims. Interestingly, none of the super-utilizers belonged to the Weatherization Plus Health group (Table 6.7).

**Table 6.7. Super-utilizer Status by Research Group**

Cross tabulation of Super-utilizer by Research Group (Individual Case Level; n=22)	Wx + H	Wx Only	HH Only	ALL
Super-utilizer	n=0 -	n=4 66.7%	n=4 66.7%	n=8 36.4%

## 6.2 IMPACT ANALYSIS

Impact analysis was conducted to derive comparisons between the sample groups. The following indicators were employed: (1) the average number of claims per month; (2) the average costs of claims per month; and (3) annualized costs. These high level indices were then used as variables in a paired

<sup>55</sup> Medical inflation was not calculated due to the range of dates within the sample and the uncertainty of calculating specific medical inflation from year to year.

samples t-test to best determine statistical difference in means between groups; Weatherization Plus Health, Healthy Homes Only and WAP Only.

The average number of claims paid by Medicaid per month was calculated for each individual case prior to the intervention and then for each month post intervention. The collective arithmetic mean for each group was then calculated for the pre- and post-intervention periods separately. A 30-day post intervention window was inserted as health care appointments may have been scheduled prior to the intervention or as retrofits completed within the home may have temporarily increased exposure to environmental triggers. The results of a paired sample t-test suggest that a statistically significant difference of means exists between the average number of claims submitted per month pre- and post-intervention within the Weatherization Plus Health and WAP Only groups (Table 6.8). There was a difference in means of -.42 and -.90 claims per month, respectively, in these groups. Although results indicate that the Healthy Homes group experienced an increase in the average number of claims per month, decreases in costs were observed in all three groups (Table 6.9). It should again be noted that the Healthy Homes group received the “simple” package of asthma reduction measures as opposed to the major measures offered through the Weatherization Plus Health program (e.g., flooring replacement, mechanical ventilation). The Healthy Homes group included participants with higher amounts of claims and costs per month overall and thus may have benefited from the additional measures provided through Weatherization Plus Health and WAP. Comparisons between study groups were calculated using analysis of variance (two-way ANOVA). These tests revealed no statically significant differences between any of the groups related to changes in the average number of claims paid per month post-intervention.

Calculations to determine intervention impacts were performed to determine costs per month and annualized costs for each study group (Table 6.9). The data suggest an increase (by \$5) in average costs per month within the Weatherization Plus Health group, but when annualized, suggest a decrease of \$85 per year. The greatest impact was observed within the Healthy Homes Only group with a mean decrease of \$1204 per year, when including inpatient costs, and a decrease of \$363 when not. Conversely, the WAP Only group experienced a mean decrease of \$785 when including inpatient costs and a decrease of \$1,026 when not. Baseline asthma-related costs for the Weatherization Plus Health group pre-intervention were considerably lower than the other two study groups, especially with the absence of any super-utilizers of the system. Additionally, this group had the longest range of months of claims collected both pre- and post-intervention. One could speculate that persistence of asthma-trigger reduction measures could have played a role, or that this group provides a better glimpse into the true impact over time for a program inclusive of all eligible children with asthma without considering severity. Finally, observations were made within the data set that the same type of claim from the same provider increased after a certain calendar year. However, the provider was not contacted to determine if the cost increase was due to medical inflation or to additional services required by study participants. Figure 6.1 captures the change in average number of claims and costs per month submitted to Medicaid for all study participants over time.

Comparisons between groups were calculated to determine statistical significance in the difference in costs paid per month post-intervention. These tests were performed using analysis of variance (two-way ANOVA) and revealed a statically significant difference between the Weatherization Plus Health and Healthy Homes groups in the mean of the average costs of claims per month post-intervention when including the costs for inpatient care ( $p < .05$ ). These tests also revealed statistically significant differences between the Weatherization Plus Health and WAP Only groups in the mean of the average costs of claims paid each month ( $p < .05$ ) and in annualized costs ( $p < .05$ ) post-intervention, but only when excluding inpatient costs.

**Table 6.8. Results from a Paired Sample T-Test Comparing Difference of Means between the Average Number of Claims Submitted Per Month Pre- and Post-Intervention by Research Group**

Paired sample t-test results for means comparison pre/post intervention using claims data by program type for individual cases (n=23)	Wx + Health (n=10)	Wx Only (n=6)	HH Only (n=7)	ALL (n=23)
Mean of the average number of claims paid per month pre-intervention	.88	1.45	1.49	1.21
Mean of the average number of claims paid per month post-intervention	.46	.55	1.59	.83
Paired differences	<b>-.42*</b>	<b>-.90*</b>	<b>+.10</b>	<b>-.38</b>

\*\*\* p<.001; \*\* p <.01; \* p<.05

**Table 6.9. Results from a Paired Sample T-Test Comparing Difference of Means between Average Costs per Claim Submitted Pre- And Post-Intervention by Research Group**

Paired sample t-test results for means comparison pre/post intervention using claims <i>cost</i> data by program type for individual cases (n=22 <sup>56</sup> )	Wx + Health (n=10)	Wx Only (n=6)	HH Only (n=6)	ALL (n=22)
Mean of the average costs of claims paid per month pre-intervention	\$52	\$108	\$104	\$81
Mean of the average costs of claims paid per month post-intervention	\$57	\$68	\$36	\$55
Paired differences	<b>+\$5</b>	<b>-\$40</b>	<b>-\$68</b>	<b>-\$26</b>
Mean of the average costs of claims paid per month pre-intervention (no inpatient)	\$52	\$108	\$61	\$70
Mean of the average costs of claims paid per month post-intervention (no inpatient)	\$57	\$45	\$36	\$48
Paired differences	<b>+\$5</b>	<b>-\$63</b>	<b>-\$25</b>	<b>-\$22</b>
Mean of the annualized costs of claims paid per month pre-intervention	\$427	\$1423	\$2003	\$1129
Mean of the annualized costs of claims paid per month post-intervention	\$342	\$638	\$799	\$548
Paired differences	<b>-\$85</b>	<b>-\$785</b>	<b>-\$1204</b>	<b>-\$581</b>
Mean of the annualized costs of claims paid per month pre-intervention (no inpatient)	\$427	\$1423	\$1175	\$903
Mean of the annualized costs of claims paid per month post-intervention (no inpatient)	\$342	\$397	\$799	\$482
Paired differences	<b>-\$85</b>	<b>-\$1026</b>	<b>-\$376</b>	<b>-\$421*</b>

\*\*\* p<.001; \*\* p <.01; \* p<.05

<sup>56</sup> One case in the HH Only group did not have enough claims data with costs included to be included in this analysis.

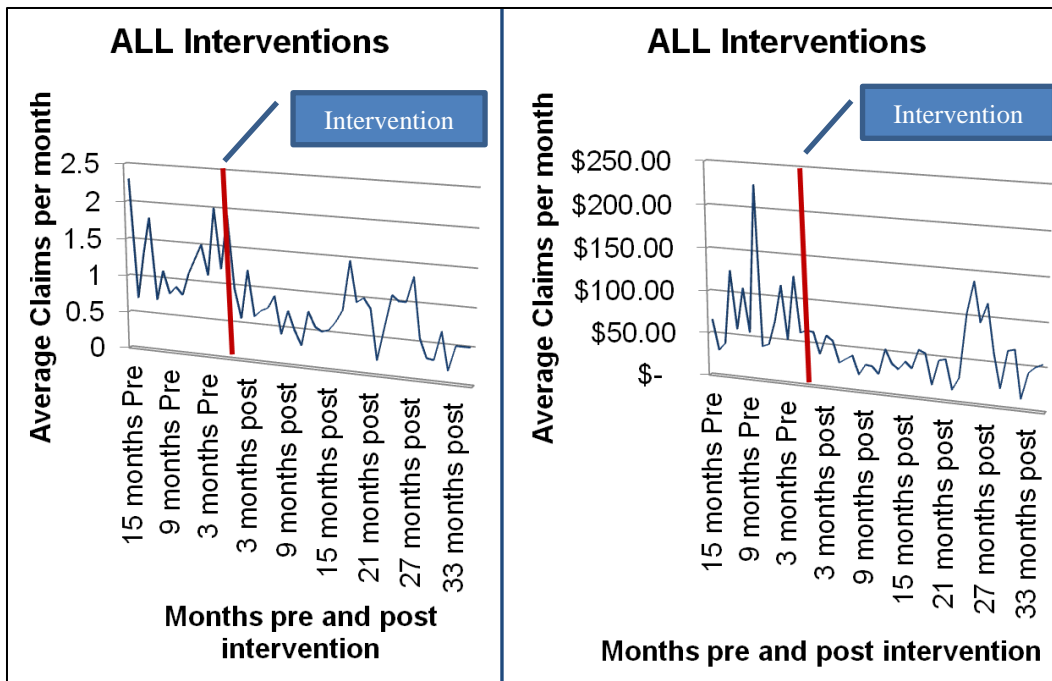


Figure 6.1. Graphic of Average Claims and Costs per Month for All Study Groups Pre- and Post-Intervention

Basic descriptive frequencies were calculated to capture the percentage of study participants in each group that had an observed decrease in each category (Table 6.10). Overall, the majority of cases in each study group and the super-utilizer group showed a decrease in the average number of claims submitted to Medicaid per month, a decrease in the average costs of those claims per month, and a decrease in annualized costs after the intervention. Overall, nearly 83% of all cases observed some decrease in the number of Medicaid claims per month post intervention, and nearly 64% of all cases observed some decrease in the cost of those claims per month post intervention. This impact increased to nearly 82% when inpatient claims were excluded.

Table 6.10. % of Cases with a Decrease in Claims and Costs by Research Group

% of cases with a decrease in claims and costs by program type	Wx + HH	Wx Only	HH Only	Super-utilizer	ALL
<b>CLAIMS</b>	n=10	n=6	n=7	n=8	n=23
Any decrease in average number of claims per month post intervention (YES)	90.0%	83.3%	71.4%	75%	82.6%
<b>COSTS</b>	n=10	n=6	n=6	n=8	n=22
Any decrease in average cost of claims per month post intervention (YES)	50.0%	66.7%	83.3%	62.5%	63.6%
Any decrease in average cost of claims per month post intervention (no inpatient) (YES)	50.0%	83.3%	66.7%	62.5%	63.6%
Any decrease in annualized cost post intervention (YES)	80.0%	83.3%	83.3%	75%	81.8%
Any decrease in annualized cost post intervention (no inpatient) (YES)	80.0%	83.3%	83.3%	75%	81.8%

Final statistical analysis was performed to identify correlations between group type, participant characteristics and conditions existing in the pre and post-intervention environments (Table 6.11). As expected, super-utilizers of the health care system were positively correlated with annualized costs both

pre- and post-intervention. The Weatherization Plus Health group was positively correlated with annualized costs in the pre-intervention period but no statistically significant relationship was found in the post-intervention environment. The Weatherization Plus Health group also contained children with better controlled asthma as indicated by a negative correlation value with participants scoring poorly on the ACT. Poor ACT scores were also negatively correlated if the study participant was male.<sup>57</sup> A positive relationship between the Healthy Homes Only group and annualized costs was observed in the pre-intervention environment and, after excluding costs for inpatient care, in the post-intervention environment. However, a statistically significant relationship was observed between that group and individuals with super-utilizer status. Interestingly, a negative correlation was observed between the Weatherization Only group and household reported observations of mold or mildew post-intervention, but a positive correlation was observed between the Weatherization Plus Health group and observations of mildew in the home post-intervention.

**Table 6.11. Statistically Significant Correlating Factors with Each Research and Super-Utilizer Group**

Statistically significant correlating factors for Medicaid Sample (n=23)		Wx + Health	Wx Only	HH Only	Super-utilizer
Annualized cost pre-intervention	Nature of relationship	-		+	+
	Coefficient of Determination (R <sup>2</sup> )	.511*		.427*	.670**
Annualized cost pre-intervention (no inpatient)	Nature of relationship	-			+
	Coefficient of Determination (R <sup>2</sup> )	.543**			.678**
Annualized cost post-intervention	Nature of relationship				+
	Coefficient of Determination (R <sup>2</sup> )				.604**
Annualized cost post-intervention (no inpatient)	Nature of relationship			+	+
	Coefficient of Determination (R <sup>2</sup> )			.454*	.568**
ACT poor control score	Nature of relationship	-			
	Coefficient of Determination (R <sup>2</sup> )	.550*			
Observation mold post-intervention	Nature of relationship		-		
	Coefficient of Determination (R <sup>2</sup> )		.422*		
Observation mildew post-intervention	Nature of relationship	+	-		
	Coefficient of Determination (R <sup>2</sup> )	.649***	.434*		
Clean more post-intervention	Nature of relationship		-		
	Coefficient of Determination (R <sup>2</sup> )		.775***		
Child has respiratory allergy	Nature of relationship		+		
	Coefficient of Determination (R <sup>2</sup> )		.533*		
Child has sinus infections	Nature of relationship				+
	Coefficient of Determination (R <sup>2</sup> )				.618
Hispanic	Nature of relationship	+			
	Coefficient of Determination (R <sup>2</sup> )	.565**			
Pets allowed on furniture post intervention	Nature of relationship	+			
	Coefficient of Determination (R <sup>2</sup> )	.439*			
Pets allowed in common areas post intervention	Nature of relationship		+		
	Coefficient of Determination (R <sup>2</sup> )		.452*		
Own Home	Nature of relationship		+		+
	Coefficient of Determination (R <sup>2</sup> )		.582**		.477*
Housing Type; Manufactured	Nature of relationship	+	-		
	Coefficient of Determination (R <sup>2</sup> )	.429*			
Super-utilizer	Nature of relationship	-	-	+	
	Coefficient of Determination (R <sup>2</sup> )	.703***		.438*	

Correlation is significant at the following levels (2-tailed): \*\*\* p<.001; \*\* p <.01; \* p<.05

<sup>57</sup> Correlation is significant at the 0.05 level (2-tailed).



## 7. CONCLUSION

Effective multi-attribute asthma reduction programs provide a public health resource mitigating a suite of evidence-based environmental triggers inside the home. Analysis of the occupant-reported and field-collected data from the three study groups revealed that both weatherization and healthy homes interventions improved dwelling quality and reduced home-source evidence-based asthma triggers with the potential for synergistic benefits of WAP plus healthy housing evident. In general, caregivers reported that their child's health had improved post-intervention and they "could run and play longer."

The data used to measure asthma morbidity for Medicaid-insured study participants residing in homes that received either Weatherization Plus Health, Healthy Homes, or standard WAP services suggest that statistically significant decreases occur in health care utilization and costs post intervention, and a statistically significant decrease was observed in annualized asthma-related Medicaid costs for all study groups collectively. The average number of claims paid by the Washington State Medicaid program per month also decreased significantly within the Weatherization Plus Health and WAP only groups. Because the Healthy Homes sample in this study included participants with higher baseline amounts of claims and costs per month overall, this group could possibly have benefited from the additional measures provided through Weatherization Plus Health and WAP. Based on these data it is reasonable to propose that the Opportunity Council give high priority to families caring for children with severe asthma considered to be super-utilizers of the health care system and to members of populations or demographics disproportionately burdened with asthma (e.g., American Indians in Washington State) to maximize the potential impact of these programs.

Overall, the services delivered by the participating agencies in this study significantly reduced health care costs for Medicaid-insured asthmatic children residing in Northwestern Washington State. However, it is important to consider additional actions caretakers take upon recognizing poor health status of children with asthma in their homes not controlled for during this study. Mitigating home-related environmental asthma triggers is but one action associated with improved asthma control and outcomes. Accessing services known to improve the dwelling quality by mitigating environmental triggers might be done in concert with other evidence-based actions. Utilization of health care services, accessing school health professionals, reducing exposure to seasonal triggers, modifying exercise, and changes in medications and dosage are but a few actions that caregivers might undertake to improve asthma-related health outcomes for their children. As part of the study, physician records were collected and combed for additional insight into these factors. This set of 10 case studies containing complete sets of survey, physician, housing intervention, and Medicaid data will be related in a separate subsequent analysis.

Research studies have sought to isolate and measure the effectiveness of home interventions targeting reductions in asthma symptoms, episodes, and costs. The current body of literature suggests that mitigating indoor environmental asthma triggers improves health outcomes for children. This study sought to explore the potential for assessing programmatic impacts through outcome measures contained in linkable Medicaid records-only and physician records research. Through this study we can conclude that it is possible to collect and link these data at individual and household levels. The research collected through this study suggests that Weatherization Plus Health, Healthy Homes, and WAP all contribute to addressing the problem of asthma as a health disparity, but additional research is required to better attribute the reductions in Medicaid claims and costs to these programs, and to generalize the results to all program recipients. For future studies, larger sample sizes will help detect differences between groups and will provide statistical power for more defensible results. Finally, persistence over time for any reduced costs and claims achieved at a programmatic level requires further investigation.





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**APPENDIX A. DATA FORMS SURVEY INSTRUMENTS  
COLLECTED DURING INTERVENTION**

## APPENDIX A. DATA FORMS AND SURVEY INSTRUMENTS COLLECTED DURING INTERVENTION

### A.1 INFORMED CONSENT FORM FOR WEATHERIZATION PLUS HEALTH STUDY



#### Researchers:

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#### **Researcher's Statement**

##### **Why is the research taking place?**

- The purpose of this research is to study possible changes in asthma after work was done in the home to reduce asthma triggers. If changes did occur we want to see if there is also a change in medical costs for treating the asthma.
- You can be included in the study because you received services through the Opportunity Council's Weatherization Plus Health program and because you still to live in the same home where the work was completed.
- Between 60 and 80 households will participate in the study.
- This research is funded through the Department of Energy. It is managed by Oak Ridge National Laboratory.

##### **What would I be asked to do?**

- You are being asked to allow the Opportunity Council to return to your home. The staff person who will visit you will walk through the home to look at the work that had been done. They will note new changes that might have been made. The staff will ask questions. They will complete a survey with you while in the home. This visit will take between one and two hours. Example of survey questions:

Have you ever been told by a doctor or other health professional that you have asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

Do you still have asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

- You are being asked to release medical information such as Medicaid for you and children in your care living in the home if they have asthma. Records will be collected from the Health Care Authority in your state. This will allow us to look at costs for asthma treatment before and after the work was done in your home. Records will also be collected from physicians who treat asthma. We will only be collecting and looking at asthma related health information. If we do receive medical information along with the asthma information, it will be destroyed if it is not directly related to asthma.
- You are being asked to sign a release of school records for children in the home with asthma. This will allow us to look at changes in school attendance, grades and use of medical services during the school day. You may be called after we receive the records if we have questions. The study will end September 30, 2012.

#### **What are the possible risks and harms if I take part?**

- As part of the study we will be collecting personal health information. If there is a breach of confidentiality, the information could be released.
- To address the risk for a breach of confidentiality we have a plan to protect the data. Records will be stored securely. We will also only be collecting asthma health information. No persons or organizations outside the Opportunity Council will have access to your information.
- If you believe an invasion of privacy or breach of confidentiality has occurred, please contact the Opportunity Council at 1.800.649.5121.

#### **What are the possible benefits?**

- This research will help us better understand whether or not reducing asthma triggers in houses results in medical cost savings. It will also help us better understand whether or not there is improvement in school attendance or performance. The results could lead to more funding with more families being served.

#### **What are my choices if I don't take part?**

- Study participation is voluntary. You may refuse to participate and can withdraw from the study at any time. You will not lose any services or benefits you normally receive from the Opportunity Council.



**Who would see study information about me?**

- All household members have a right to privacy. Your agreement for us to collect records is voluntary.
- All names, medical and personal information will be protected and kept secure at the Opportunity Council. Researchers outside of the Opportunity Council will not have access to personal identifiable information.
- Family members will not be identified when the results of the study are published.
- School and/or daycare records on nurse visits, medication given during the school day and absences due to illness will be collected. No information on any person in the study will be given to the school.
- Follow up calls to the physician who treats the asthma may occur if the records collected are not clear. No personal information collected from other sources will be shared with anyone outside of the study.
- The results from the study will be shared with the client at the end of the study.
- Data containing personal information will be destroyed by 9/30/14.

**Would I be paid for my time? Will the study cost me anything?**

- You will receive \$200 payment for your participation at the time of the home visit.
- This study will not cost you anything.

**What else do I need to know?**

- You are not required to answer all questions or complete all study procedures.
- All suspected abuse or neglect of children will be reported to Child Protective Services.
- All suspected abuse of dependent adults will be reported to Adult Protective Services.
- You may call the investigators toll-free or collect if he/she has any questions about the research. You can call at 1.800.649.5121.

<i>Investigator Signature</i>	<i>Date</i>
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**If you agree to participate:**

- The study described above has been explained to me. By signing below, I voluntarily consent to participate in this research. I have been told that I can refuse to answer any question or leave the study at any time, without penalty. I have had a chance to ask questions. I have been told that I may call the researchers if I have any questions about the research.

<i>Subject Signature</i>	<i>Date</i>
<i>Parent/Guardian Signature (if applicable)</i>	<i>Date</i>
<i>Witness/Advocate Signature (if applicable)</i>	<i>Date</i>

## A.2. HOUSING UNIT INFORMATION SURVEY – DF2

OMB Control Number: 1910-5168

Expiration Date: 6/30/2015

**Thank you for your prompt response to this data request which is part of the ARRA-period evaluation of the Weatherization Assistance Program. Evaluation results will provide essential feedback to the weatherization community and inform policymakers about the program's effects on clients' energy consumption, cost savings, and non-energy benefits.**

This data form collects detailed information about homes weatherized by your agency in Program Year 2010. The information you supply will be used with billing history data to better understand energy savings attributable to the Weatherization Assistance Program under ARRA.

Please use this form (DF2) to provide information about any single family detached and attached houses, mobile homes, or individual units within multi-family buildings. The Building Information Survey (DF3) should be used to document information on small or large multifamily buildings in which the whole building and all units in the building were weatherized or are waitlisted. Refer to the definitions of each building type provided at the end of the survey because these definitions are slightly different than those commonly used within the Weatherization Assistance Program.

All of the information obtained from this survey will be protected and will remain confidential. The data will be analyzed in such a way that the information provided cannot be associated back to your state, your agencies, or the housing units and clients that your state served.

Thank you in advance for completing this survey.

Public reporting burden for this collection of information is estimated to average twenty hours per weatherization agency, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of the Chief Information Officer, Records Management Division, IM-11, Paperwork Reduction Project (44 USC 3501-3520), U.S. Department of Energy, 1000 Independence Ave SW, Washington, DC, 20585-1290; and to the Office of Management and Budget (OMB), OIRA, Paperwork Reduction Project (44 USC 3501-3520), Washington, DC 20503.

Form completed by: \_\_\_\_\_ Date: \_\_\_\_\_

**IDENTIFICATION**

[Q1-5 will be pre-completed by the evaluation team]

- 1. Agency name: \_\_\_\_\_
- 2. State: \_\_\_\_\_
- 3. Agency job number: \_\_\_\_\_
- 4. Occupant name: \_\_\_\_\_
- 5a. Site address: \_\_\_\_\_ 5b. City: \_\_\_\_\_

**WEATHERIZATION INFORMATION**

Weatherization dates (not audit or inspection dates):

- 6a. Started: \_\_\_\_\_
- 6b. Completed: \_\_\_\_\_  
(month) (day) (year)

- 7. Was this a “reweatherized” unit? (*check only one*)
  - Yes
  - No
  - Don’t know

***Check “yes” if the home was weatherized prior to PY 2010.***

**HOUSING UNIT**

- 9. Building type: (*check only one*)
  - Single-family detached house
  - Single-family attached house (e.g., side-by-side duplex, townhouse, row house)
  - Single-family – unknown whether attached or detached
  - Mobile home
  - Small multifamily building (2-4 units per building and not a SF attached house)
  - Large multifamily building (5 or more units per building and not a SF attached house)
  - Shelter
  - Don’t know
- 10. Number of stories above grade: (*check only one*)
  - 1
  - 2
  - 3
  - 4 or more
  - Don’t know
  - Not applicable

***Please list the number of stories above ground-level. If there are half-stories, round up to the nearest whole number. For example, please check “2” for a 1.5-story split-level house.***

13. If small or large multifamily building, number of units in the building: (*check only one*)

- 2
- 3
- 4
- 5-9
- 10-19
- 20-29
- 30-49
- 50-99
- 100 or more
- Don't know
- Not applicable

14. Year house/building originally built: (*check only one*)

- 2000 or later
- 1990 to 1999
- 1980 to 1989
- 1970 to 1979
- 1960 to 1969
- 1950 to 1959
- 1940 to 1949
- 1930 to 1939
- 1920 to 1929
- 1910 to 1919
- 1900 to 1909
- Before 1900
- Don't know

Conditioned floor area at the time of weatherization:

15a. Heated floor area: \_\_\_\_\_ ft<sup>2</sup>

Don't know

***Include the basement only if it is intentionally conditioned (heated and/or cooled). If you only know the total square footage of the home, please select “don't know” rather than listing the total square footage.***

15c. Does this home have a basement?

- Yes
- No
- Don't know

***A basement is a space under the living space of the home that is at least 5 feet tall. It is either partially or completely under the ground.***

15d. Does this home have a crawl space under any part of the living space of the home?

- Yes
- No
- Don't know

***A crawl space is a space under the living space of the home that is less than 5 feet tall. It can be all above ground, partially below ground, or completely below ground.***

***Exclude a crawl space under a porch, unless the porch is enclosed and used for living space.***

15e. Does this home have a concrete slab under any part of the living space of the home?

- Yes
- No
- Don't know

***Exclude a concrete slab under the garage.***

15f. Does this home have any other type of foundation under any part of the living space of the home?

- Yes
- No
- Don't know

16. Primary fuel used to heat the unit during the winter before weatherization: (***check only one***)

- Electricity
- Natural gas
- Propane/LPG
- Fuel oil
- Wood
- Other (specify: \_\_\_\_\_)
- Don't know

17. Primary fuel used for water heating before weatherization: (***check only one***)

- Natural gas
- Propane/LPG
- Electricity
- Other (specify: \_\_\_\_\_)
- Don't know

18. Type of *primary* space-heating system before weatherization: (***check only one***)

- Central (ducted) warm-air furnace (forced-air or gravity, any fuel including electricity)
- Heat pump
- Built-in electric units (e.g., electric baseboards, ceiling heat)
- Steam or hot water system (e.g., floor or baseboard radiators, convectors)
- Floor, wall, or pipeless (ductless) furnace (e.g., floor or wall furnace)
- Room/space heater (nonportable)
- Portable space heater

- Cooking stove
- None
- Don't know

**Select "steam or hot water system" for homes heated with boilers.**

19. If small or large multifamily building, was the primary space-heating system shared with other housing units? (**check only one**)

- Yes
- No
- Don't know
- Not applicable

20. Supplemental fuel(s) used to heat the unit during the winter before weatherization: (**check all that apply**)

- Electricity
- Natural gas
- Propane/LPG
- Fuel oil
- Wood
- Other (specify: \_\_\_\_\_)
- Don't know
- None

21. Type of operable air conditioning system present before weatherization: (**check all that apply**)

- Central air conditioner/heat pump
- Window/wall units
- Evaporative cooling system ("swamp coolers")
- None
- Don't know

**AUDIT**

23. Primary method used to select weatherization measures for this house (excluding health, safety, and repair measures and general heat waste measures): (**check only one**)

- Priority list
- Calculation procedure (e.g., spreadsheet, computerized audit)
- Other (specify: \_\_\_\_\_)

\*FOR THE NEXT TWO SECTIONS, PLEASE "INSTALLED" FIRST, FOLLOWED BY "INSTALLED BY"

Diagnostic measurement	Pre-weatherization	Post weatherization
House air leakage (blower door measurement):		
32a. Air leakage rate	cfm	cfm

32b. House WRT outside pressure difference <sup>58</sup>	Pa	Pa
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### MEASURES INSTALLED

If you know whether in-house crew or a contractor installed a given measure, please check the appropriate box in the first two response columns. If a measure was installed but you do not know whether it was installed by in-house crew or a contractor, please check the box in the “Installed?” column.

Measure	Installed by		Installed?
	In-house crew	Contractor	
Air sealing work:			
36a. General house caulking and weatherstripping (e.g., doors, windows)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36b. Air sealing emphasizing bypasses (leaks identified by auditor and/or crew <b><u>without using a blower door</u></b> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36c. Air sealing emphasizing bypasses (leaks identified by auditor and/or crew <b><u>with aid of a blower door</u></b> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36d. Air distribution system (duct) sealing or repair <sup>59</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36e. Repairs to broken windows, doors, or other major holes in the building shell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36f. Other non-window air sealing work (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36g. Other non-window air sealing work (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measure	Installed by		Installed?
	In-house crew	Contractor	
37a. Attic or ceiling insulation <sup>60</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If attic insulation was installed, please provide quantity: 37b. _____ square feet or 37c. _____ pounds  37d. What was the R value of attic insulation prior to weatherization? _____ (Leave blank if unknown. Enter 0 if there was no existing insulation.)			
37e. Wall insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<sup>58</sup> Report the pressure differential at which the blower door test was performed. A typical value is 50 Pascals. Do not report baseline pressure (typically less than 5 Pascals).

<sup>60</sup> Exclude kneewall insulation, which should be listed under 37o, “other insulation.”



Measure	Installed by		
	In-house crew	Contractor	Installed?
If wall insulation was installed, please provide quantity: 37f. _____ square feet or 37g. _____ pounds			
37h. Floor insulation <sup>61</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37i. Rim or band joist insulation (sill box)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37j. Foundation wall insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37k. Duct insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37l. White roof coat applied to mobile home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37m. Mobile home skirting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37n. Mobile home belly insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37o. Other insulation (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37p. Other insulation (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Windows:			
38a. New window (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38b. New window (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38c. If new windows were installed, please provide quantity: _____			
38d. Window glass repair or replacement not included under air sealing major holes in building shell (36e)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38e. Repair of window sashes or frames			
38f. Window screen repair/replacement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38g. Window lock replacement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38h. Storm window installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38i. Window shading (e.g., awning, film, sun screen)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38j. Other window treatments (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38k. Other window treatments (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<sup>61</sup> Exclude mobile home belly insulation, which should be listed under 37n.

Measure	Installed by		
	In-house crew	Contractor	Installed?
Doors:			
39a. New door (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39b. New door (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39c. Door lock (new or replacement)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39d. Door or door framing repair not included under air sealing major holes in building shell (36e)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39e. Storm door installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39f. Other door treatments (specify: _____ )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39g. Other door treatments (specify: _____ )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Central space heating systems (e.g., furnaces, boilers): <sup>62</sup>			
40a. New heating system (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40b. New heating system (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40c. Space-heating system repair (e.g., controls, safety items, flues)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40d. Space-heating system tune-up			
40e. New ductwork installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40f. Vent damper installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40g. Intermittent ignition device installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40h. Other heating system modification (specify: _____ ) <sup>63</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40i. Other heating system modification (specify: _____ )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measure	Installed by		
	In-house crew	Contractor	Installed?
Air-conditioning systems:			

<sup>62</sup> Include central heating systems installed through programs other than WAP, such as emergency heating system replacements funded by LIHEAP.

<sup>63</sup> Check 36d if duct sealing or duct repair was performed. Check 40d if new ductwork was installed. Check 43c if new vents, grills or registers were installed.

Measure	Installed by		
	In-house crew	Contractor	Installed?
41a. New air conditioner (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41b. New air conditioner (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41c. Air conditioner repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41d. Air conditioner recharge/tune-up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41e. Ceiling or whole-house fans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41f. Other air-conditioning system modification (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41g. Other air-conditioning system modification (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ventilation:			
42a. New bathroom exhaust fan installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42b. New kitchen exhaust fan installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42c. Repair to kitchen or bathroom exhaust fan (including ductwork)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42d. Whole-house ventilation system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42e. Other ventilation system improvements (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42f. Other ventilation system improvements (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HVAC accessories:			
43a. New programmable (setback) thermostat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43b. New standard thermostat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43c. New duct vents, grills, or registers installed <sup>64</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43d. Standard air filter installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43e. High efficiency particulate arresting (HEPA) air filter installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43f. Other HVAC accessories (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43g. Other HVAC accessories (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<sup>64</sup> Check 36d if duct sealing OR duct repair was performed. Check 40d if new ductwork was installed.

Measure	Installed by		
	In-house crew	Contractor	Installed?
Water-heating system:			
44a. New water heater (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44b. New water heater (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44c. Water-heating system repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44d. Water-heater tank insulation wrap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44e. Pipe insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44f. Installed low-flow showerhead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44g. Installed low-flow device on faucet (aerator)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44h. Water heater temperature reduction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44i. Other water heating system measure (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44j. Other water heating system measure (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other baseloads:			
45a. Indoor lighting (energy efficient bulb or fixture)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45b. Outdoor lighting (energy efficient bulb or fixture)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45c. Lighting (indoor/outdoor location not recorded)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45d. Refrigerator (justified because cost effective)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45e. Refrigerator (justified for reason other than cost effectiveness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45f. Other baseload measure (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45g. Other baseload measure (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health and safety and repair:			
46a. Smoke alarm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46b. CO monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46c. Attic ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46d. Clothes dryer vent repair or replacement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measure	Installed by		
	In-house crew	Contractor	Installed?
46e. Roof repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46f. Ceiling repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46g. Wall repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46h. Floor repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46i. Foundation repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46j. Ground vapor barrier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46k. Gutter or downspout (installed or repaired)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46l. Plumbing repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46m. Sewer repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46n. Electrical repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46o. Stair repair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46p. Install/repair non-skid material on stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46q. Install/repair safety gate at stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46r. Install/repair grab bar in bathroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46s. Install/repair non-skid material in bathtub	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46t. Install/repair metal chimney liner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46u. Lead abatement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46v. Asbestos abatement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46w. Removal or safe storage of household poisons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46x. Other health and safety/repair items (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46y. Other health and safety/repair items (specify: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Client education:			
47a. Did the occupants receive an in-home visit in which energy education was provided?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know		
47b. Did the occupants participate in a classroom training in which energy education was provided?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know		

**SERC AND WIPP MEASURES INSTALLED**

*Please skip Questions 48 through 58 if no SERC or WIPP funds were spent on this home.*

48. Please indicate whether any additional measures were installed in this unit that were funded by the Sustainable Energy Resources for Consumers (SERC) Program and/or Weatherization Innovation Pilot Program (WIPP).

- SERC-funded measures were installed
- WIPP-funded measures were installed
- Both SERC- and WIPP-funded measures were installed
- The unit was not part of a SERC or WIPP grant (go to Question 61)

Measure	Installed by		
	In-house crew	Contract or	Installed?
<b>RENEWABLE ENERGY</b>			
49a. S1.1 Solar photovoltaic (PV)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49b. S1.2 PV shingles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49c. S1.3 Wind: small-scale residential	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49d. S1.4 Passive solar panel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>HOT WATER SYSTEMS</b>			
50a. S2.1 Solar hot water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50b. S2.2 Tankless/on-demand hot water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50c. S2.3 Condensing hot water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50d. S2.4 Heat pump/hybrid hot water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50e. S2.5 Combination hot water and boiler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50f. S2.6 Other hot water (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>HVAC SYSTEMS</b>			
51a. S3.1 Heat pumps: geothermal/ground-source	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51b. S3.2 Heat pumps: air	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51c. S3.3 Heat pumps: mini split system ductless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51d. S3.4 Replacement of improperly sized HVAC equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51e. S3.5 Solar thermal (space heating)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51f. S3.6 Wood pellet stoves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51g. S3.7 Ultra cooling systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51h. S3.8 Central AC units	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measure	Installed by
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	In-house crew	Contractor	Installed?
51i. S3.11 High-efficiency furnaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51j. S3.16 Solar powered attic ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51k. S3.17 Energy recovery ventilator (ERV)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ROOFING: COOL ROOF</b>			
52a. S4.1 Roofing: Cool roof technology installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>APPLIANCES</b>			
53a. S5.1 ENERGY STAR clothes washer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53b. S5.2 Energy-efficient clothes dryer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53c. S5.3 Energy-efficient refrigerator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53d. S5.4 Appliance energy meters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>INSULATION</b>			
54a. S6.1 Insulation: Aerogel/super	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54b. S6.2 Insulation: Foam injection technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54c. S6.3 Insulation: Masonry foam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54d. S6.4 Insulation: Radiant barrier attic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54e. S6.5 Insulate: Spray foam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54f. S6.6 Insulation: Reflective attic insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>WHOLE-HOUSE RETROFIT</b>			
55a. S7.1 Centralized building controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55b. S7.2 Deep energy retrofits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55c. S7.3 High-performance space conditioning retrofits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55d. S7.4 High-performance building envelope retrofits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55e. S7.5 Cold energy retrofits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55f. S7.6 Warm energy retrofits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55g. S7.7 Foundation improvements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>OUTREACH</b>			
56a. S8.1 Home Energy Saver workshops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56b. S8.2 Household touched by behavioral change message	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>EQUIPMENT</b>			
57a. S9.1 Monitoring: In-home energy monitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measure	Installed by		
	In-house crew	Contractor	Installed?
OTHER			
58a. S10.1 Window upgrades	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58b. S10.2 Outdoor solar security lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58c. S10.3 Ceiling fans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58d. S10.4 LED lights	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58e. S10.5 ENERGY STAR doors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

61. If a new space-heating system was installed, indicate the primary fuel used to heat the unit during the winter after weatherization: (*check only one*)

- Natural gas
- Propane/LPG
- Kerosene (#1 fuel oil)
- Fuel oil (#2 fuel oil)
- Electricity
- Wood
- Coal
- Other (specify: \_\_\_\_\_)
- Don't know
- Not applicable

62. If a new space-heating system was installed, indicate the type of *primary* space-heating system after weatherization: (*check only one*)

- Central (ducted) warm-air furnace (forced-air or gravity, any fuel including electricity)
- Heat pump
- Built-in electric units (e.g., electric baseboards, ceiling heat)
- Steam or hot water system (e.g., floor or baseboard radiators, convectors)
- Floor, wall, or pipeless (ductless) furnace (e.g., floor or wall furnace)
- Room/space heater (nonportable)
- Portable space heater
- Cooking stove
- Other (specify: \_\_\_\_\_)
- Don't know
- Not applicable

*Select "steam or hot water system" for homes heated with boilers.*

## COSTS

68. Provide the total cost of weatherizing this housing unit. Include **ALL** sources of funding. Do **NOT** include program management costs (e.g., intake, audits, final inspections or program administration) or installation-related overhead costs (e.g., vehicles, equipment and training).



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69. Divide the total costs spent on this housing unit (from Question 68) into the categories below.

69a. Material costs	
69b. Labor costs	
69c. Enter total job cost if above categories are not known	
69d. Total (should match Q68 total)	

70. Divide the labor costs (from Question 69b) into the categories below. If labor costs for in-house crew are not tracked at the job level please leave 70a blank.

70a. In house crew labor <sup>1</sup>	
70b. Contractor labor	
70c. Profit/overhead <sup>2</sup>	
70d. Enter total labor costs if above categories are not known	
70e. Total (should match Q68b total)	

<sup>1</sup>Crew-based labor costs should be based on the crew's fully loaded hourly rate (rather than the crew's take-home pay rate) which may include costs associated with medical and other insurance, workers compensation, vacations, and other benefits. These labor costs should include the crew's time for traveling to and from the job site.

<sup>2</sup>If contractor profit and overhead are included in the contractor's material and labor costs, then leave 70c blank.

71. Provide estimates of non-monetary contributions to this weatherization job.

71a. Volunteer Hours <sup>1</sup>	
71b. Apprentice Hours <sup>2</sup>	
71c. Estimated Value of Material In-Kind Contributions	
71d. Estimated Value of Other In-Kind Contributions	

<sup>1</sup>An example of a volunteer is an unpaid person working on weatherizing a Habitat for Humanity Home.

<sup>2</sup>An example of an apprentice would be a student whose program of education requires hands-on, real-life work on weatherization jobs.

72. Divide the total costs spent on this housing unit (from Question 68) into the categories below.

72a. Cost effective energy-related measures (SIR > 1.0)	
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72b. Health and safety and other non-cost effective measures	
72c. Incidental repairs	
72d. Enter total job cost if above categories are not known	
72e. Total (should match Q68 total)	

73. Divide the total costs spent on this housing unit (from Question 68) into these funding source categories below.

73a. DOE funds (ARRA and formula WAP funds)	
73b. DOE SERC Funds	
73c. DOE WIPP Funds	
73d. Non-DOE (leveraged) funds	
73e. Total (should match Q68 total)	

***Energy Assistance Program (LI-HEAP) funding should be considered Non-DOE funds if it is tracked separately.***

74. Provide the amounts spent on the major measure categories below.

74a. HVAC measures	
74b. Water heating measures	
74c. Replacement windows and doors	
74d. All other building shell measures (insulation, air sealing, etc.)	

### A.3. ASTHMA HOME ENVIRONMENT CHECKLIST (EPA)



# ASTHMA HOME ENVIRONMENT

# C H E C K L I S T

Home visits provide an opportunity to educate and equip asthma patients with the tools to effectively manage their disease in concert with a physician's care. This checklist—designed for home care visitors—provides a list of questions and action steps to assist in the identification and mitigation of environmental asthma triggers commonly found in and around the home. The checklist is organized into three sections—building information, home interior and room interior. The room interior is further subdivided by categories (such as bedding and sleeping arrangements, flooring, window treatments, and moisture control). This will allow the home care visitor to focus on the specific activities or things in a room—in particular the asthma patient's sleeping area—that might produce or harbor environmental triggers. The activities recommended in this checklist are generally simple and low cost. Information on outdoor air pollution follows the checklist. The last page includes information on U.S. Environmental Protection Agency (EPA) resources and an area for the home care visitor to record a home visit summary.

If the patient's sensitivities to allergens (such as dust mites, pests, warm-blooded pets and mold) and irritants (such as secondhand smoke and nitrogen dioxide) are known, the home care visitor should begin by focusing on relevant areas. This checklist covers the following allergens and irritants, which are commonly found in homes. Information is also provided on chemical irritants—found in some scented and unscented consumer products—which may worsen asthma symptoms.

#### Dust Mites

*Triggers:* Body parts and droppings.  
*Where Found:* Highest levels found in mattresses and bedding. Also found in carpeting, curtains and draperies, upholstered furniture, and stuffed toys. Dust mites are too small to be seen with the naked eye and are found in almost every home.

#### Pests (such as cockroaches and rodents)

*Triggers:* Cockroaches – Body parts, secretions, and droppings.  
Rodents – Hair, skin flakes, urine, and saliva.  
*Where Found:* Often found in areas with food and water such as kitchens, bathrooms, and basements.

#### Warm-Blooded Pets (such as cats and dogs)

*Triggers:* Skin flakes, urine, and saliva.  
*Where Found:* Throughout entire house, if allowed inside.

#### Mold

*Triggers:* Mold and mold spores which may begin growing indoors when they land on damp or wet surfaces.  
*Where Found:* Often found in areas with excess moisture such as kitchens, bathrooms, and basements. There are many types of mold and they can be found in any climate.

#### Secondhand Smoke

*Trigger:* Secondhand smoke – Mixture of smoke from the burning end of a cigarette, pipe or cigar and the smoke exhaled by a smoker.  
*Where Found:* Home or car where smoking is allowed.

#### Nitrogen Dioxide (combustion by-product)

*Trigger:* Nitrogen dioxide – An odorless gas that can irritate your eyes, nose, and throat and may cause shortness of breath.  
*Where Found:* Associated with gas cooking appliances, fireplaces, woodstoves, and unvented kerosene and gas space heaters.

ASTHMA HOME ENVIRONMENT **CHECKLIST**

**BUILDING INFORMATION**

(This information may be helpful to determine reasonable mitigations.)

What type of building does the patient live in?  House  
 Duplex  
 Apartment  
 Mobile home  
 Other \_\_\_\_\_

Notes:

Does the patient own or rent?  Own  
 Rent

Notes:

Questions	Answers	Action Steps
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**HOME INTERIOR** ▲ **MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.**

**Secondhand Smoke**

Does anyone smoke in the home or car?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>Keep the home and car smoke-free.</li> <li>Do not allow visitors to smoke in the home.</li> <li>Take the smoke-free home pledge and post a smoke-free home decal or magnet to show that the house is a "smoke-free" zone.</li> </ul>
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Notes:

**Warm-blooded Pets (such as cats and dogs)**

Is the patient's asthma worse when around warm-blooded pets?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>If possible, remove the pet from the home or keep the pet outside.</li> <li>If this is not possible, keep the pet out of the patient's sleeping area and off of the furniture.</li> </ul>
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Notes:

**Consumer Products**

Is the patient's asthma worse when around chemicals or products with strong odors (such as cleaners, paints, adhesives, pesticides, air fresheners, or cosmetics)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>Limit patient's exposure as much as possible by minimizing product use, using products only when patient is not present, or trying alternative products.</li> <li>If products are used, carefully follow manufacturer's instructions on the label and make sure the area is well ventilated.</li> </ul>
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Notes:

**Heating and Cooling Systems**

Does the heating and cooling system use filters?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>If so, replace the filters quarterly.</li> <li>Use filters with higher efficiency than standard furnace filters, such as upgraded pleated filters, if heating or cooling system manufacturer's specifications allow.</li> </ul>
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Notes:

Questions	Answers	Action Steps
<b>H O M E I N T E R I O R</b> (continued)		
Does the heating system use a fuel-burning appliance (such as an oil or gas furnace)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<p>▲ <b>MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.</b></p> <ul style="list-style-type: none"> <li>▲ Have the heating system - including furnaces, flues and chimneys - professionally inspected annually.</li> <li>▲ Promptly repair cracks or damaged parts.</li> </ul>
Notes:		
Are supplemental heating sources used? (Check all that apply)	<input type="checkbox"/> Fireplace <input type="checkbox"/> Wood-burning stove <input type="checkbox"/> Unvented kerosene or gas space heater <input type="checkbox"/> Other _____	<ul style="list-style-type: none"> <li>■ Properly ventilate the room where a fuel-burning appliance is used. Consider using appliances that vent to the outside whenever possible.</li> <li>■ Never use a gas-cooking appliance as a heating source.</li> <li>■ If using a fireplace, make sure it is properly vented to help ensure smoke escapes through the chimney.</li> <li>■ If using a wood-burning stove, make sure that doors are tight-fitting. Use aged or cured wood only and follow the manufacturer's instructions for starting, stoking, and putting out the fire.</li> <li>■ If using an unvented kerosene or gas space heater, follow the manufacturer's instructions for proper fuel to use and keep the heater properly adjusted.</li> </ul>
Notes:		
Are there air conditioning window units?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Run window air conditioner with the vent control open to increase the outdoor ventilation rate during the cooling season.</li> </ul>
Notes:		
<b>R O O M I N T E R I O R</b>		
<b>Bedding and Sleeping Arrangements</b>		
What does the patient sleep on? (Check all that apply)	<input type="checkbox"/> Mattress with box springs <input type="checkbox"/> Sofa <input type="checkbox"/> Other _____	<ul style="list-style-type: none"> <li>▲ Cover patient's mattress in a dust-proof (allergen impermeable) zippered cover. Clean cover according to manufacturer's instructions.</li> <li>■ If it is necessary for the patient to sleep on upholstered furniture such as a sofa, then cover furniture with washable slipcovers or sheets and vacuum furniture regularly (including removing cushions and vacuuming in cracks and crevices).</li> </ul>
Notes:		
What types of bedding does the patient use? (Check all that apply)	<input type="checkbox"/> Bedspread (e.g., comforter, quilt) <input type="checkbox"/> Blankets <input type="checkbox"/> Pillows <input type="checkbox"/> Sheets <input type="checkbox"/> Other (e.g., sleeping bag) _____	<ul style="list-style-type: none"> <li>■ Choose washable bedding.</li> <li>■ Wash bedding regularly in hot water and dry completely.</li> <li>▲ Cover patient's pillow in a dust-proof (allergen impermeable) zippered cover. Clean cover according to manufacturer's instructions.</li> </ul>
Notes:		

ASTHMA HOME ENVIRONMENT CHECKLIST

Questions	Answers	Action Steps
<b>ROOM INTERIOR</b> (continued) <span style="float: right;">▲ MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.</span>		
<b>Flooring</b>		
What type of floor covering is present? (Check all that apply)	<input type="checkbox"/> Carpeting <input type="checkbox"/> Hardwood floor, tile, or vinyl flooring <input type="checkbox"/> Throw rugs <input type="checkbox"/> Other _____	<ul style="list-style-type: none"> <li>■ If carpeting is present, vacuum carpets, area rugs, and floors regularly.</li> <li>■ If possible, use a vacuum cleaner with a high efficiency filter.</li> <li>■ Mop hard surface floors regularly.</li> <li>■ Wash throw rugs regularly in hot water. Dry completely.</li> <li>■ Clean baseboards regularly using a damp cloth with warm, soapy water.</li> <li>■ Someone besides the patient should vacuum, sweep, empty the dust canister and change the vacuum bag.</li> <li>■ If possible, the patient should stay out of rooms when they are being vacuumed or swept.</li> <li>■ If the patient vacuums, sweeps, empties the dust canister, or changes the vacuum bag, he or she should wear a dust mask.</li> </ul>
Notes:		
<b>Upholstered Furniture and Stuffed Toys</b>		
Is there upholstered furniture present?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Cover upholstered furniture with washable slipcovers or sheets.</li> <li>■ Vacuum upholstered furniture regularly, including removing cushions and vacuuming in cracks and crevices.</li> <li>▲ If replacing furniture, consider purchasing a non-upholstered furniture - such as vinyl, wood, or leather - that can be easily wiped down.</li> </ul>
Notes:		
Are stuffed toys present?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Choose washable stuffed toys, and wash frequently in hot water. Dry completely.</li> <li>■ Limit the number of stuffed toys in patient's bed and sleeping area.</li> </ul>
Notes:		
<b>Window Treatments</b>		
What window coverings are present? (Check all that apply)	<input type="checkbox"/> Curtains or drapes <input type="checkbox"/> Blinds <input type="checkbox"/> Shades <input type="checkbox"/> Other _____	<ul style="list-style-type: none"> <li>■ Vacuum drapes regularly.</li> <li>■ Wash and dry curtains regularly.</li> <li>■ Dust window sills, blinds, and shades regularly using a damp cloth with warm, soapy water. Dry completely.</li> <li>▲ If possible, replace curtains or drapes with plastic, vinyl, wood, or aluminum blinds.</li> </ul>
Notes:		
<b>Cooking Appliances</b>		
Are gas cooking appliances used?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ When cooking with a gas appliance, turn on an exhaust fan or open a window.</li> <li>■ Avoid misuse of the appliance by following the manufacturer's instructions for operation.</li> </ul>
Notes:		

Questions	Answers	Action Steps
<b>R O O M I N T E R I O R</b> (continued)		▲ <b>MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.</b>
<b>Moisture Control</b>		
Is there evidence of water damage, moisture, or leaks (such as damp carpet or leaky plumbing)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Dry damp or wet items within 24-48 hours to avoid mold growth.</li> <li>▲ Fix water leaks (such as leaky plumbing) as soon as possible.</li> <li>▲ Replace absorbent materials, such as ceiling tiles and carpet, if mold is present.</li> <li>▲ Use air conditioner or dehumidifier to maintain low indoor humidity. If possible, keep indoor humidity below 60% (ideally between 30-50%) relative humidity.</li> </ul>
<i>Notes:</i>		
Do you see or smell mold or mildew (such as in the bathroom on tub, shower, walls, or windows)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Open a window or turn on an exhaust fan when there is excessive moisture in the room, such as when showering or cooking.</li> <li>■ Scrub mold off hard surfaces with detergent and water. Dry completely.</li> <li>■ Clean up mold and dry surfaces completely before painting or caulking.</li> <li>▲ Replace absorbent materials, such as ceiling tiles and carpet, if mold is present.</li> </ul>
<i>Notes:</i>		
Is standing water present (such as in refrigerator drip pans, air conditioner drip pans, or house plants)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Empty and clean refrigerator and air conditioner drip pans regularly.</li> <li>■ Avoid standing water in plant containers.</li> </ul>
<i>Notes:</i>		
Are humidifiers used in the patient's house?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Use humidifier only when conditions require it, use the correct setting to maintain indoor relative humidity between 30-50 percent, and clean humidifier reservoirs regularly.</li> <li>■ Use low mineral content water to prevent the build-up of scale and dispersal of minerals into the air.</li> <li>■ Follow manufacturer's instructions for use, maintenance, and replacement of any materials supplied with the humidifier.</li> </ul>
<i>Notes:</i>		
Are rooms and moisture-producing appliances—such as stoves, clothes dryers, or dishwashers—properly vented (including venting to the outside if specified by the manufacturer)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Increase ventilation or air movement by opening doors and/or windows when practical. Use fans as needed.</li> <li>■ Run the bathroom exhaust fan or open the window when showering.</li> <li>■ Use exhaust fans or open windows whenever cooking or washing dishes.</li> <li>■ Vent appliances properly according to manufacturer's specifications.</li> </ul>
<i>Notes:</i>		

ASTHMA HOME ENVIRONMENT **CHECKLIST**

Questions	Answers	Action Steps
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**R O O M I N T E R I O R** (continued) ▲ **MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.**

**Pest Control**

Is there evidence of cockroaches and/or rodents (such as droppings or dead specimens in traps)?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Clean all surfaces where you have seen pests.</li> <li>■ Use poison baits, boric acid, or traps to kill pests. Minimize use of sprays. If sprays are used: limit the spray to the infested area, carefully follow the instructions on the label, make sure there is plenty of fresh air where the spray is being used and, if possible, keep patient out of the room.</li> </ul>
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Notes:

Are there food crumbs or open or unsealed food?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Clean all food crumbs or spilled liquids right away.</li> <li>■ Store food in sealed containers.</li> <li>■ Remove food, bags, newspapers, and empty boxes, cans, and bottles from the sleeping area.</li> <li>■ Put all garbage in plastic trash bags. Seal trash bags and put them into garbage cans with fitted lids every day.</li> </ul>
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Notes:

Are there holes or gaps between construction materials and pipes that could allow pests to enter the house?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Seal holes or gaps between construction materials and pipes, or ask the owner to do so.</li> </ul>
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Notes:

Is there evidence of standing water or leaks?	<input type="checkbox"/> Y <input type="checkbox"/> N	<ul style="list-style-type: none"> <li>■ Dry damp or wet items within 24-48 hours to avoid mold growth.</li> <li>■ Avoid standing water in house plant containers and drip pans.</li> <li>▲ Fix water leaks (such as leaky plumbing) as soon as possible.</li> </ul>
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Notes:

**O U T D O O R A I R P O L L U T I O N**

Exposure to air pollution (mainly ozone and particle pollution) can trigger asthma attacks. The Air Quality Index (AQI) is a tool to provide the public with clear and timely information on local air quality and whether air pollution levels pose a possible health concern. The AQI is reported and forecasted every day in many areas throughout the U.S. on local weather reports and through national media. Asthma attacks are most likely to occur the day **after** outdoor pollution levels are high.

People can take simple steps to reduce their exposure to outdoor air pollution. When the AQI reports unhealthy levels:

- ▶ Limit physical exertion outdoors.
- ▶ Consider changing the time of day of strenuous outdoor activity to avoid the period when air pollution levels are high or consider postponing sports activities to another time.
- ▶ Reduce the intensity of the activity, or spend less time engaged in strenuous activities. For example, coaches can rotate players more frequently in strenuous sports, like soccer. Resting players reduces their exposure to air pollution.

To learn more about and access the AQI, visit [www.epa.gov/airnow](http://www.epa.gov/airnow).





## A.4. ASTHMA CONTROL TEST FOR CHILDREN AGE 4 TO 11 YEARS

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_ Child's Name: \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

### Childhood Asthma Control Test for children 4 to 11 years.

This test will provide a score that may help the doctor determine if your child's asthma treatment plan is working or if it might be time for a change.

#### How to take the Childhood Asthma Control Test

Step 1 Let your child respond to the first four questions (1 to 4). If your child needs help reading or understanding the question, you may help, but let your child select the response. Complete the remaining three questions (5 to 7) on your own and without letting your child's response influence your answers. There are no right or wrong answers.

Step 2 Write the number of each answer in the score box provided.

Step 3 Add up each score box for the total.

Step 4 Take the test to the doctor to talk about your child's total score.

**19  
or less**

If your child's score is 19 or less, it may be a sign that your child's asthma is not controlled as well as it could be. Bring this test to the doctor to talk about the results.

#### Have your child complete these questions.

1. How is your asthma today?

 <b>0</b> Very bad	 <b>1</b> Bad	 <b>2</b> Good	 <b>3</b> Very good
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SCORE

2. How much of a problem is your asthma when you run, exercise or play sports?

 <b>0</b> It's a big problem. I can't do what I want to do.	 <b>1</b> It's a problem and I don't like it.	 <b>2</b> It's a little problem but it's okay.	 <b>3</b> It's not a problem.
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3. Do you cough because of your asthma?

 <b>0</b> Yes, all of the time.	 <b>1</b> Yes, most of the time.	 <b>2</b> Yes, some of the time.	 <b>3</b> No, none of the time.
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4. Do you wake up during the night because of your asthma?

 <b>0</b> Yes, all of the time.	 <b>1</b> Yes, most of the time.	 <b>2</b> Yes, some of the time.	 <b>3</b> No, none of the time.
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#### Please complete the following questions on your own.

5. During the last 4 weeks, how many days did your child have any daytime asthma symptoms?

<b>5</b> Not at all	<b>4</b> 1-3 days	<b>3</b> 4-10 days	<b>2</b> 11-18 days	<b>1</b> 19-24 days	<b>0</b> Everyday
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6. During the last 4 weeks, how many days did your child wheeze during the day because of asthma?

<b>5</b> Not at all	<b>4</b> 1-3 days	<b>3</b> 4-10 days	<b>2</b> 11-18 days	<b>1</b> 19-24 days	<b>0</b> Everyday
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7. During the last 4 weeks, how many days did your child wake up during the night because of asthma?

<b>5</b> Not at all	<b>4</b> 1-3 days	<b>3</b> 4-10 days	<b>2</b> 11-18 days	<b>1</b> 19-24 days	<b>0</b> Everyday
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TOTAL

Courtesy of Bellingham Asthma Allergy & Immunology

**A.5. HEALTHY HOMES ACTION PLAN**



**Name:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**My Indoor Air Quality & Energy Conservation Action Plan**

Three Steps to Improve your *Indoor Air Quality*

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Three Steps to Improve your *Energy Bills*

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

The Opportunity Council Representative has explained what we need to do to make this action plan work for us. We can call the representative at the Opportunity council if we have any questions.

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Educator:** \_\_\_\_\_ **Phone:** \_\_\_\_\_

## A.6. SATISFACTION SURVEY

Strongly Disagree = 1

Disagree = 2

Neither Agree nor Disagree = 3

Agree = 4

Strongly Agree = 5

1. Before participating in the Opportunity Council's Healthy Homes program I already knew many ways to reduce asthma triggers in my home.
2. The information provided in the Healthy Homes program increased my desire to reduce asthma triggers in my home.
3. The information and educational material provided was clear and concise.
4. The information and educational material provided was useful for reducing asthma triggers in my home.
5. I will be able to easily use many of the methods the Opportunity Council staff provided for reducing asthma triggers in my home.
6. I do not worry as much or as often about my child's asthma acting up.
7. My child's asthma interferes less with my job or work around the house.
8. My child is able to sleep through the night more regularly.
9. I get a full night's sleep more often.
10. I feel confident my child can take part in normal children's activities.
11. I understand more ways to reduce asthma triggers in my home.
12. I/We are working on quitting smoking.
13. I make a point of always smoking outside the house or car to reduce my child's exposure to 2nd hand smoke.
14. I ventilate more often by opening windows and running exhaust fans, etc. to reduce asthma triggers in my home.
15. I better understand how to prevent and control mold in my home.
16. I can identify the specific things that set off my child's asthma.
17. I feel like I have better control over my child's asthma.

What steps were you already taking to reduce asthma triggers in your home before receiving Healthy Homes services from Opportunity Council? (Check all that apply)

Yes = -1

No = Missing

- 18a. Shoes-OFF policy
- 18b. Ventilate more often
- 18c. Reduce chemical irritants
- 18d. Quit smoking
- 18e. Use dust mite covers
- 18f. Wash bedding in hot water
- 18g. Smoke outside only
- 18h. Improve general cleaning
- 18i. Fix water leaks
- 18j. Damp-cloth dusting
- 18k. Use walk-off mats
- 18l. Vacuum carpet/furniture regularly
- 18m. Replace furnace filter
- 18n. Vacuum out heating vents
- 18o. Clean mold (using non-toxic cleaner)
- 18p. Reduce pet triggers
- 18q. Reduce stuffed animals
- 18r. Safely store chemicals out of reach
- 18s. Other \_\_\_\_\_ (string)
- 18t. Other \_\_\_\_\_ (string)

What changes have you made to further reduce asthma triggers in your home after receiving Healthy Homes services from Opportunity Council? (Check all that apply)

Yes = -1

No = Missing

- 19a. Shoes-OFF policy

- 19b. Ventilate more often
- 19c. Reduce chemical irritants
- 19d. Quit smoking
- 19e. Use dust mite covers
- 19f. Wash bedding in hot water
- 19g. Smoke outside only
- 19h. Improve general cleaning
- 19i. Fix water leaks
- 19j. Damp-cloth dusting
- 19k. Use walk-off mats
- 19l. Vacuum carpet/furniture regularly
- 19m. Replace furnace filter
- 19n. Vacuum out heating vents
- 19o. Clean mold (using non-toxic cleaner)
- 19p. Reduce pet triggers
- 19q. Reduce stuffed animals
- 19r. Safely store chemicals out of reach
- 19s. Other\_\_\_\_\_ (string)
- 19t. Other\_\_\_\_\_ (string)


20. What did you like most about the Healthy Homes Program?

\_\_\_\_\_ (string)

21. Do you have any suggestions for improving our Healthy Homes program?

\_\_\_\_\_ (string)

## A.7. POLLUTION SOURCE SURVEY

		Date: _____ Assessor: _____	
1)	Family members less than 4 or more than 60 yrs old	Yes	No
2)	Any household members with asthma, respiratory problems or flu like symptoms?	Yes	No
3)	Is anyone living in the house pregnant?	Yes	No
How old is the house?			
4)	Paint peeling or flaking on floors, walls, ceilings?	Yes	No
5)	Has carpet ever been water soaked?	Yes	No
6)	Is carpet covering a concrete floor?	Yes	No
7)	Any unvented combustion appliances in the home?	Yes	No
8)	Do household members smoke inside the home?	Yes	No
9)	Do cars park in attached garage?	Yes	No
10)	Seasonal water pooling in crawl space?	Yes	No
11)	Plumbing leaks in crawlspace?	Yes	No
12)	Noticeable leaks or water staining on ceilings or walls?	Yes	No
13)	Indoor pets?	Yes	No
14)	Paints, solvents, thinners, pesticides stored in home?	Yes	No
15)	House keeping problems? Clutter / Unsanitary	Yes	No
16)	Has this house been tested for Radon?	Yes	No
17)	Are Insecticides or rodenticides used in home or ductwork?	Yes	No
18)	Other		
19)	Unusual odors in the house?	Yes	No
20)	Is moisture noticeable on windows?	Yes	No
21)	Visible mold anywhere in house?	Yes	No
22)	House temp. unusually warm or cold	Yes	No
23)	Humidity levels unusually high?	Yes	No

**APPENDIX B. SURVEY INSTRUMENTS COLLECTED OVER COURSE  
OF STUDY**





## APPENDIX B. SURVEY INSTRUMENTS (COLLECTED OVER COURSE OF STUDY)

### B.1. OCCUPANT SURVEY

#### Table of Contents

- A. INTRO
- B. HEATING & VENTILATION & HOME APPLIANCES
- C. HOME CONDITIONS
- D. HEALTH CARE & COVERAGE
- E. HEALTH & WELL BEING
- F. CHEMICAL IRRITANTS, CLEANING AND PETS IN THE HOME
- G. EMPLOYMENT / SCHOOL
- H. DEMOGRAPHICS

#### Instructions for interviewer and respondent

##### Interviewer:

- Read each question in its entirety and read all possible answers to respondent before asking for a response

##### Respondent

- The interviewer may repeat all or part of any question and/or possible answers
- You may ask to have any question and/or answered clarified
- You may refuse any question

#### A. INTRO

PLEASE RECORD RESPONDENT'S NAME, GENDER and AGE

Name

Gender Age

Main Respondent: \_\_\_\_\_

A1. How long have you lived in your current home?

{If less than one year} Enter: \_\_\_\_\_ months

Enter: \_\_\_\_\_ years

A2. Including yourself, how many people normally live in this household? Do not include anyone who is just visiting, those away in the military, or children who are away at college.

Enter Number \_\_\_\_\_

A3. Can you please tell me their first names, gender and age, and your relationship to the people in your household?

	First Name	Gender	Age	Relationship	In school (Y/N)
Person 1.					
Person 2.					
Person 3.					
Person 4.					
Person 5.					
Person 6.					
Person 7.					
Person 8.					
Person 9.					
Person 10.					

## **B. HEATING & VENTILATION & HOME APPLIANCES**

### **HEATING**

B1. Let's start with the main source of heating in your home. Please tell me which type of heating equipment provides *most* of the heat for your home. Remember to include portable heaters, fireplaces, heating stoves and cooking stoves.

- (1) Central furnace with ducts to individual rooms
- (2) Heating stove burning wood, coal, or coke
- (3) Fireplace
- (4) Built-in electric units in each room installed in walls, ceilings, baseboards, or floors
- (5) Heat pump
- (6) Portable heaters
- (7) Steam/Hot water system with radiators or pipes in each room
- (8) Built-in floor/wall pipeless furnace
- (9) Built-in room heater burning gas, oil, or kerosene
- (10) Cooking stove used to heat your home as well as to cook
- (11) Some other equipment (Specify \_\_\_\_\_)
- (12) Don't Know/Not Sure
- (13) Refused

B2. What is the *main* fuel used for heating your home? That is, which fuel is the one that provides the most heat for your home?

- (1) Electricity
- (2) Natural gas from underground pipes
- (3) Propane (bottled gas)
- (4) Wood
- (5) Fuel oil
- (6) Kerosene

- (7) Biomass
- (8) Solar or Wind
- (9) Geothermal
- (10) District steam
- (11) Some other fuel (Specify \_\_\_\_\_)
- (12) Don't Know/Not Sure
- (13) Refused

B3. You told me that [B2] is the main source of heat in your home. In the past 12 months, did you use any other types of heating equipment? Remember to include portable heaters, fireplaces, heating stoves and cooking stoves. CHECK ALL THAT APPLY

- (1) No other equipment
- (2) Central furnace with ducts to individual rooms
- (3) Heating stove burning wood, coal, coke, or biomass (such as pellets or corn)
- (4) Fireplace
- (5) Built-in electric units in each room installed in walls, ceilings, baseboards, or floors
- (6) Heat pump
- (7) Portable heaters
- (8) Steam/Hot water system with radiators or pipes in each room
- (9) Built-in floor/wall pipeless furnace
- (10) Built-in room heater burning gas, oil, or kerosene
- (11) Cooking stove used to heat your home as well as to cook
- (12) Some other equipment (Specify \_\_\_\_\_)
- (13) Don't Know/Not Sure
- (14) Refused

B4. What fuel does the [B3] use? CHECK ALL THAT APPLY

- (1) Electricity
- (2) Natural gas from underground pipes
- (3) Propane (bottled gas)
- (4) Fuel oil
- (5) Kerosene
- (6) Wood
- (7) Biomass (wood pellets or corn)
- (8) Solar or Wind
- (9) Geothermal
- (10) District steam
- (11) Some other fuel (Specify \_\_\_\_\_)
- (12) Don't Know/Not Sure
- (13) Refused

B5. {IF YES HEATING STOVE OR FIREPLACE} In the past 12 months how often did you have to burn garbage, cardboard, plastics, foam, colored ink, magazines, boxes, or wrappers to keep warm?

- (1) Never
- (2) Once
- (3) Sometimes
- (4) Often
- (5) Most of the winter
- (6) Don't Know/Not Sure
- (7) Refused
- (8) NA

B6. {IF YES HEATING STOVE OR FIREPLACE} In the past 12 months how often did you have to burn coated, painted, or pressure-treated wood, driftwood, plywood, particle board, or any wood with glue in it to keep warm?

- (1) Never
- (2) Once
- (3) Sometimes
- (4) Often
- (5) Most of the winter
- (6) Don't Know/Not Sure
- (7) Refused
- (8) NA

B7. {IF YES HEATING STOVE OR FIREPLACE} In the past 12 months how often did you have to burn wet, rotted, diseased, or moldy wood to keep warm?

- (1) Never
- (2) Once
- (3) Sometimes
- (4) Often
- (5) Most of the winter
- (6) Don't Know/Not Sure
- (7) Refused
- (8) NA

B8. Approximately, how often does someone in your household change (or clean) the air filter in your heating system?

- (1) Monthly
- (2) Every three months
- (3) Every six months
- (4) Once a year
- (5) Once every two years
- (6) Don't change (or clean) it
- (7) Air filter is changed by service company
- (8) Don't Know/Not Sure
- (9) Refused

B9. During the winter, what is the temperature set at when *someone is inside* your home *during the day*? [IF NO ANSWER, PROBE 1: THEN AT WHAT TEMPERATURE IS THE THERMOSTAT SET? PROBE 2: CAN I JUST HAVE YOUR BEST ESTIMATE?]

Enter degrees Fahrenheit \_\_\_\_\_

B10. During the winter, what is the temperature set at when *no one is inside* your home *during the day*? [IF NO ANSWER, PROBE 1: THEN AT WHAT TEMPERATURE IS THE THERMOSTAT SET? PROBE 2: CAN I JUST HAVE YOUR BEST ESTIMATE?]

Enter degrees Fahrenheit \_\_\_\_\_

B11. During the winter, what is the temperature set at inside your home *at night*? [IF NO ANSWER, PROBE 1: THEN AT WHAT TEMPERATURE IS THE THERMOSTAT SET? PROBE 2: CAN I JUST HAVE YOUR BEST ESTIMATE?]

Enter degrees Fahrenheit \_\_\_\_\_

- B12. Which of the following statements best describes the indoor temperature of your home during the winter *before* your home was weatherized?
- (1) Very cold
  - (2) Cold
  - (3) Comfortable
  - (4) Hot
  - (5) Very hot
  - (6) Other \_\_\_\_\_
  - (7) Refused
- B13. Which of the following statements best describes the indoor temperature of your home during the winter *after* your home was weatherized?
- (1) Very cold
  - (2) Cold
  - (3) Comfortable
  - (4) Hot
  - (5) Very hot
  - (6) Other \_\_\_\_\_
  - (7) Refused

**KITCHEN**

- B14. What fuel does the cooking stove and/or oven use? CHECK ALL THAT APPLY
- (1) Electricity
  - (2) Natural gas from underground pipes
  - (3) Propane (bottled gas)
  - (4) Fuel oil
  - (5) Kerosene
  - (6) Wood
  - (7) Some other fuel (Specify \_\_\_\_\_)
  - (8) No working stove or oven in the home
  - (9) Don't Know/Not Sure
  - (10) Refused

- B15. How often is an exhaust fan that vents to the outside used when cooking in your kitchen?
- (1) Never
  - (2) Rarely
  - (3) Sometimes
  - (4) Often
  - (5) Every time
  - (6) Don't Know/Not Sure
  - (7) Refused

**VENTILATION**

- B16. How often are your windows open in the summer?
- (1) Never
  - (2) Rarely
  - (3) Sometimes
  - (4) Frequently
  - (5) All the time
  - (6) Don't Know/Not Sure
  - (7) Refused

- B17. How often are your windows open in the winter?
- (1) Never
  - (2) Rarely
  - (3) Sometimes
  - (4) Frequently
  - (5) All the time
  - (6) Don't Know/Not Sure
  - (7) Refused

- B18. Does your clothes dryer vent directly to the outdoors?
- (1) Yes
  - (2) No
  - (3) Dryer is ventless
  - (4) Don't Know/Not Sure
  - (5) Refused

- B19. Does your main bathroom have a ventilation fan in it that works?
- (1) Yes
  - (2) No (SKIP to B22)
  - (3) Don't know/Not Sure (SKIP to B22)
  - (4) Refused

- B20. How often do you or members of your household operate the fan while showering?
- (1) Never
  - (2) Rarely
  - (3) Sometimes
  - (4) Frequently
  - (5) All the time
  - (6) Don't Know/Not Sure
  - (7) Refused
- B21. How long after showering do you or members of your household operate the fan?
- (1) Don't turn the fan on for showers
  - (2) The fan is turned off when leaving the shower area
  - (3) 1-5 minutes
  - (4) 6-15 minutes
  - (5) 16-30 minutes
  - (6) 30-60 minutes
  - (7) More than 1 hour
  - (8) Don't know/Not Sure
  - (9) Refused
- B22. In the past 12 months, how many months was a dehumidifier used?
- (1) None / don't have dehumidifier
  - (2) 1 to 3 months,
  - (3) 4 to 6 months,
  - (4) 7 to 9 months,
  - (5) 10 to 11 months, but not all year,
  - (6) All year long
  - (7) Don't Know/Not Sure
  - (8) Refused

### **C. HOME CONDITIONS**

- C1. Does your home have a garage that is attached to or part of your home?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused
- C2. Do you warm up your vehicle in your garage?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused
- C3. Do you see evidence of an infestation of cockroaches or other insects?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused



- C4. If so, how infested is your home with cockroaches or other insects?
- (1) Extremely infested
  - (2) Very infested
  - (3) Somewhat infested
  - (4) Hardly infested
  - (5) Not infested at all
  - (6) Don't Know/Not Sure
  - (7) Refused
- C5. What have you done about the cockroaches or other insects?
- (1) Nothing
  - (2) Used insecticides, bug sprays, or poison
  - (3) Hired an exterminator or other professional
  - (4) Other, please specify \_\_\_\_\_
  - (5) Don't Know/Not Sure
  - (6) Refused
- C6. Do you see evidence of rats, mice, or other rodents entering any part of your home (living space, crawl space, attic)?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused
- C7. If so, how infested is your home with rats or mice?
- (1) Extremely infested
  - (2) Very infested
  - (3) Somewhat infested
  - (4) Hardly infested
  - (5) Not infested at all
  - (6) Don't Know/Not Sure
  - (7) Refused
- C8. What have you done about the rodents?
- (1) Nothing
  - (2) Used bait or poison
  - (3) Hired an exterminator or other professional
  - (4) Other, please specify \_\_\_\_\_
  - (5) Don't Know/Not Sure
  - (6) Refused
- C9. Does your home frequently have a mildew odor or musty smell?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused
- C10. How often do you observe standing water anywhere in your home?
- (1) Never
  - (2) Rarely

- (3) Sometimes
- (4) Often
- (5) Always
- (6) Don't Know/Not Sure
- (7) Refused

C11. Have you seen mold in your home in the past 12 months?

- (1) Yes
- (2) No {SKIP to D1}
- (3) Don't Know/Not Sure
- (4) Refused

C12. {If YES MOLD} What have you done about the mold?

- (1) Nothing
- (2) Cleaned with bleach
- (3) Cleaned with other chemical mold remover
- (4) Cleaned with natural mold remover (vinegar or natural product)
- (5) Air Conditioned
- (6) Ventilation (fans)
- (7) Used a dehumidifier
- (8) Contacted a Professional
- (9) Other, please specify \_\_\_\_\_
- (10) Don't Know/Not Sure
- (11) Refused

**D. HEALTH CARE & COVERAGE**

D1. In the past 12 months has your child(ren) with asthma had any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicaid?

- (2) Yes
- (3) No
- (4) Refused

D2. {IF YES} What type of health insurance does your child(ren) have?

- (1) Medicaid (Molina, Healthy Options, CHIP)
- (2) S-CHIP
- (3) Basic Health
- (4) Private individual or group insurance
- (5) Don't Know/Not Sure
- (6) Refused

D3. {IF YES COVERAGE} During the past 12 months was there any time that your child(ren) did not have any health insurance coverage?

- (2) Yes
- (3) No
- (4) Don't Know/Not Sure
- (5) Refused

D4. What are the name(s) and contact info of your child(ren)'s current health care providers?

- 1) General Practitioner  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_
- 2) Asthma/Allergy Specialist  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_
- 3) Other  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_
- 4) Other  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

**E. HEALTH & WELL BEING**

**YOUR HEALTH**

READ: Next, I am going to ask you questions about your health.

E1. Have you ever been told by a doctor or other health professional that you have asthma?

- (1) Yes
- (2) No {SKIP to E7}
- (3) Don't Know/Not Sure
- (4) Refused

E2. Do you still have asthma?

- (1) Yes
- (2) No {SKIP to E7}
- (3) Don't Know/Not Sure
- (4) Refused

E3. {IF YES} During the past 12 months, how many times did you see a doctor or health professional for a routine checkup for your asthma? \_\_\_\_\_

READ: Symptoms of asthma include coughing, wheezing, shortness of breath, chest tightness or phlegm production when you have a cold or respiratory infection.

E4. How long has it been since you last had any symptoms of asthma?

- (1) Never
- (2) Less than one day ago
- (3) 1-6 Days ago
- (4) 1 week to less than 3 months ago
- (5) 3 months to less than 1 year ago
- (6) 1 year to less than 3 years ago
- (7) 3 years to 5 years ago
- (8) More than 5 years ago
- (9) Don't Know/Not Sure
- (10) Refused

E5. During the past 12 months did you have to stay overnight in the hospital because of asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E6. Not counting hospitalizations, during the past 12 months, did you go to an emergency room because of asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

### **YOUR CHILD(REN)'S HEALTH**

READ: Next, I am going to ask you whether your child(ren) have had particular health problems in the last 3 months. In the past 3 months, has your child(ren) had . . .

E7. Shortness of breath when lying down, waking up, or with light work or light exercise?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E8. Headaches that are either new or more frequent or severe than before?

- (1) Yes
- (2) No
- (3) Don't know
- (4) Refused

In the past 12 months has your child(ren) had or been told by a doctor or health professional that they have...

E9. Lead poisoning

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refuse

E10. Three or more ear infections per year

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E11. Any kind of respiratory allergy (ex. reaction to dust mites, mold, pet dander or pollen)

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E12. Flu

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E13. Persistent Cold symptoms lasting more than 14 days (SYMPTOMS INCLUDE  
COUGHING, SORE THROAT, SNEEZING, SINUS PAIN, CONGESTION, FEVER, FATIGUE,  
AND HEADACHE)

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E14. Sinus infection or Sinusitis

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E15. Bronchitis

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E16. Have you ever been told by a doctor or other health professional that your child(ren)  
has asthma?

- (1) Yes
- (2) No {SKIP to F1}
- (3) Don't Know/Not Sure
- (4) Refused

E17. Does your child(ren) still have asthma?

- (1) Yes
- (2) No {SKIP to F1}
- (3) Don't Know/Not Sure
- (4) Refused

E18. {IF YES} During the past 12 months, how many times did you see a doctor or health professional  
for a routine checkup for your child(ren)'s asthma? \_\_\_\_\_

READ: Symptoms of asthma include coughing, wheezing, shortness of breath, chest tightness or phlegm production when you have a cold or respiratory infection.

E19. How long has it been since your child(ren) last had any symptoms of asthma?

- (1) Never
- (2) Less than one day ago
- (3) 1-6 Days ago
- (4) 1 week to less than 3 months ago
- (5) 3 months to less than 1 year ago
- (6) 1 year to less than 3 years ago
- (7) 3 years to 5 years ago
- (8) More than 5 years ago
- (9) Don't Know/Not Sure
- (10) Refused

E20. During the past 12 months did your child(ren) stay overnight in the hospital because of asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

E21. Not counting hospitalizations, during the past 12 months, did your child(ren) go to an emergency room because of asthma?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

READ: In this section I will be asking about care systems you currently use for your asthmatic child.

E22. Do you have an existing strategy or plan for if your child's asthma acts up and you're not available?

- (1) Yes
- (2) No
- (3) Refused
- (4) Don't Know/Not Sure

E23. Who do you ask for help from if you're not available when your child's asthma acts up? {List as relationship to client}.

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_

- E24. Have you instructed friends, neighbors, and/or family members about what to do if your child's asthma acts up?
- (1) Yes
  - (2) No
  - (3) Refused
  - (4) Don't Know/Not Sure
- E25. Have you instructed friends, neighbors, and/or family members about what triggers your child's asthma so that your child is not exposed to triggers as often?
- (1) Yes
  - (2) No
  - (3) Refused
  - (4) Don't Know/Not Sure
- E26. Does your child seem to feel better more of the time since receiving Weatherization and Healthy Homes services?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure
  - (4) Refused
- E27. Since receiving Weatherization and Healthy Homes services is your child able to run and play longer without resting?
- (1) Yes
  - (2) No
  - (3) Refused
  - (4) Don't Know/Not Sure
- E28. In the past 12 months, has anyone in the household been poisoned by breathing in carbon monoxide, and therefore went to see a medical professional?
- (1) Yes
  - (2) No
  - (3) Refused
  - (4) Don't Know/Not Sure

## **F. CHEMICAL IRRITANTS, CLEANING IN THE HOME AND PETS**

READ: In this section I will be asking questions about chemical irritants in the home, cleaning, and pets

- F1. Which one of the following statements best describes the rules about smoking in your home?
- (1) No one is allowed to smoke anywhere inside your home
  - (2) Smoking is allowed at some places or at sometimes
  - (3) Smoking is permitted anywhere
  - (4) Don't Know/Not Sure
  - (5) Refused
- F2. Are there paints, solvents, thinners or pesticides stored inside the home?
- (1) Yes
  - (2) No
  - (3) Don't Know/Not Sure

(4) Refused

F3. Are there paints, solvents, thinners or pesticides stored under the sink or in a place where children have easy access?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F4. Are there chemical based cleaning supplies stored inside the home?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F5. Are there chemical based cleaning supplies stored under the sink or in a place where children have easy access?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F6. Are there natural, non-toxic cleaners present in the home?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F7. *Before* receiving Weatherization and Healthy Homes services, how much of the time did you use chemical based cleaning supplies, chemical air fresheners, perfumes, scented candles or insecticide in your home compared to a safer, more asthma-friendly alternative?

{PROBE: scented laundry products, chemical air fresheners, chemical-based cleaners, perfumes, scented candles, insecticides, etc.}

- (1) All of the time
- (2) Most of the time
- (3) Some of the time
- (4) A little of the time
- (5) Never
- (6) Don't Know/Not Sure
- (7) Refused

F8. *After* receiving Weatherization and Healthy Homes services, how much of the time did you use chemical based cleaning supplies, chemical air fresheners, perfumes, scented candles or insecticide in your home compared to a safer, more asthma-friendly alternative?

{PROBE: scented laundry products, chemical air fresheners, chemical-based cleaners, perfumes, scented candles, insecticides, etc.}

- (1) All of the time
- (2) Most of the time
- (3) Some of the time
- (4) A little of the time
- (5) Never



- (6) Don't Know/Not Sure
- (7) Refused

F9. Do you own a HEPA vacuum?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F10. Do you clean and vacuum more often since receiving Weatherization and Healthy Homes services?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

**PETS**

F11. Do you have pets?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F12. Are pets allowed in the home?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F13. Are pets permitted on furniture?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

F14. Are pets restricted to common areas?

- (1) Yes
- (2) No
- (3) Don't Know/Not Sure
- (4) Refused

**G. EMPLOYMENT/SCHOOL**

G1. Are you or other adults in the household currently...?

- (1) Employed outside the home
- (2) Self-employed outside the home
- (3) Out of work for more than 1 year (SKIP to G4)
- (4) Out of work for less than 1 year
- (5) A Homemaker (SKIP to G4)
- (6) A Student
- (7) Retired (SKIP to G4)
- (8) Unable to work (SKIP to G4)
- (9) Refused

G2. {IF ANSWERED (1) or (2) or (4) or (6) TO G1 }In the past 12 months, about how many days of work or school did you or another adult in the home miss because of asthma related symptoms of your child?

- (1) Enter Number \_\_\_\_\_ days
- (2) None
- (3) Don't Know/Not Sure
- (4) Refused

G3. Does your child(ren) attend school (including pre-school or daycare)?

- (1) Yes
- (2) No
- (3) Refused

1) School Information

Name of School: \_\_\_\_\_  
Grade: \_\_\_\_\_  
Primary contact for asthma related issues: \_\_\_\_\_  
Phone: \_\_\_\_\_

2) School Information

Name of School: \_\_\_\_\_  
Grade: \_\_\_\_\_  
Primary contact for asthma related issues: \_\_\_\_\_  
Phone: \_\_\_\_\_

G4. In the past 12 months, about how many days of school (including pre-school or daycare) has your child(ren) missed because of asthma-related symptoms?

- (1) Enter Number: \_\_\_\_\_ days
- (2) Not in School
- (3) Don't Know/Not Sure
- (4) Refused

## **H. DEMOGRAPHICS**

READ: In this section I will be asking demographics questions.

H1. Are you currently...?

- (1) Married
- (2) Divorced
- (3) Widowed
- (4) Separated
- (5) Never married
- (6) A member of an unmarried couple
- (7) Refused

H2. Which best describes your ethnicity?

- (1) Hispanic
- (2) Non-Hispanic
- (3) Refused

H3. Which best describes your race?

- (1) White
- (2) Black or African-American
- (3) American Indian or Alaska Native
- (4) Asian
- (5) Native Hawaiian or Other Pacific Islander
- (6) Other (if volunteered)
- (7) Refused

H4. Do you rent or own your current residence?

- (1) Rent
- (2) Own
- (3) Neither (Please describe the housing agreement)
- (4) Refused

H5. Which of the following best describes the location of your home? Do you live in a city, a town, the suburbs, or in a rural area?

- (1) City
- (2) Town
- (3) Suburbs
- (4) Rural
- (5) Don't Know/Not Sure
- (6) Refused



## **B.2. WALK THROUGH CHECKLIST (WEATHERIZATION PLUS HEALTH)**

### **General Exterior**

1. Is there water pooled in the crawl space?
  - a. Yes
  - b. No
  - c. Crawl space not present
  - d. N/A, Unknown
2. Is there a vapor barrier present?
  - a. Yes
  - b. No
  - c. N/A, Unknown
3. Are there plumbing leaks in the crawl space?
  - a. Yes
  - b. No
  - c. N/A, Unknown

### **General Interior**

4. What type of flooring does the living room have?
  - a. Hard Surface with 0-2 area rugs
  - b. Hard Surface with 3+ area rugs
  - c. Carpet
  - d. N/A, Unknown
5. Is there noticeable evidence of water damage, moisture or leaks on walls or ceiling?
  - a. Yes
  - b. No
  - c. N/A, Unknown
6. Is moisture noticeable on the windows?
  - a. Yes
  - b. No
  - c. N/A, Unknown
7. What is the relative humidity level in the main living area?
  - a. 30%-50%
  - b. 50%-60%
  - c. 60%-80%
  - d. 80%+
  - e. N/A, Unknown
8. Is there evidence of extra sources of moisture in the home? (fish tank(s), dripping faucets, excessive # of houseplants, use of humidifiers, etc.)
  - a. Yes
  - b. No
  - c. N/A, Unknown
9. Is mold visible anywhere in the home?
  - a. Yes
  - b. No
  - c. N/A, Unknown
10. Is there evidence of paint peeling or flaking on floors, walls, or ceilings?
  - a. Yes
  - b. No
  - c. N/A, Unknown

### **Heating Systems**

11. Does the heating and cooling system use filters?
  - a. Yes
  - b. No
  - c. N/A, Unknown
12. Does the filter exhibit evidence of having been cleaned or replaced in the last six months?
  - a. Yes
  - b. No
  - c. N/A, Unknown
13. Does the heating source use a combustion fuel?
  - a. Yes
  - b. No
  - c. N/A, Unknown
14. Is the heating unit properly vented to the outside?
  - a. Yes
  - b. No
  - c. N/A, Unknown

### **Child's Bedroom #1 (or main room child sleeps in)**

15. What type of flooring does the child's bedroom have?
  - a. Hard Surface with 0-2 area rugs
  - b. Hard Surface with 3+ area rugs
  - c. Carpet
  - d. N/A, Unknown
16. Is there an allergy mattress cover in use?
  - a. Yes
  - b. No
  - c. N/A, Unknown
17. Are there allergy pillow covers in use?
  - a. Yes
  - b. No
  - c. N/A, Unknown
18. Are there stuffed animals on the bed?
  - a. Yes
  - b. No
  - c. N/A, Unknown
19. If yes, how many?
  - a. 1-3
  - b. 3-5
  - c. 5 or more
  - d. N/A, Unknown

### **Child's Bedroom #2 (or main room child sleeps in)**

20. What type of flooring does the child's bedroom have?
  - a. Hard Surface with 0-2 area rugs
  - b. Hard Surface with 3+ area rugs
  - c. Carpet
  - d. N/A, Unknown
21. Is there an allergy mattress cover in use?

- a. Yes
  - b. No
  - c. N/A, Unknown
22. Are there allergy pillow covers in use?
- a. Yes
  - b. No
  - c. N/A, Unknown
23. Are there stuffed animals on the bed?
- a. Yes
  - b. No
  - c. N/A, Unknown
24. If yes, how many?
- a. 1-3
  - b. 3-5
  - c. 5 or more
  - d. N/A, Unknown

### **Kitchen**

25. Are gas cooking appliances used?
- a. Yes
  - b. No
  - c. N/A, Unknown
26. Is there an exhaust fan on the range that vents to the outside?
- a. Yes
  - b. No
  - c. N/A, Unknown
27. If yes, does it appear to work (pull minimum of ~25 cfm)?
- a. Yes
  - b. No
  - c. N/A, Unknown

### **Bathroom**

28. Is there an exhaust fan in main bathroom?
- a. Yes
  - b. No
  - c. N/A, Unknown
29. What is the approximate CFM of the fan?
- a. 0-25 cfm
  - b. 25-50 cfm
  - c. 50+ cfm
  - d. N/A, Unknown

### **Laundry Area**

30. Is laundry area excessively humid (60%+ RH)?
- a. Yes
  - b. No
  - c. N/A, Unknown
31. Is dryer properly vented to outside?
- a. Yes
  - b. No
  - c. N/A, Unknown

32. Is dryer vent kinked/smashed/excessively twisted/damaged?
- a. Yes
  - b. No
  - c. N/A, Unknown

**Pets**

33. Is there evidence of pets present in the home?
- a. Yes
  - b. No
  - c. N/A, Unknown
34. Is there pet fur or dander visible on the furniture?
- a. Yes
  - b. No
  - c. N/A, Unknown
35. Is there evidence of pet hair or dander in child(ren)'s room?
- a. Yes
  - b. No
  - c. N/A, Unknown

**Chemical Storage & Cleaning Supplies**

36. Are there unusual smells in the home?
- a. Yes
  - b. No
  - c. N/A, Unknown
37. Are there paints, solvents, thinners or pesticides stored in visible locations?
- a. Yes
  - b. No
  - c. N/A, Unknown
38. Are there chemical based cleaning supplies stored visible locations?
- a. Yes
  - b. No
  - c. N/A, Unknown
39. Are there natural, non-toxic cleaners present in the home?
- a. Yes
  - b. No
  - c. N/A, Unknown

**Rodents and Insects**

40. Is there evidence of rodents in the home, attic, or crawlspace?
- a. Yes
  - b. No
  - c. N/A, Unknown
41. Are rodenticides in use in the home or ductwork?
- a. Yes
  - b. No
  - c. N/A, Unknown
42. Is there evidence of insect infestation in the home?
- a. Yes
  - b. No
  - c. N/A, Unknown



43. Are insecticides in use in the home or ductwork?
- a. Yes
  - b. No
  - c. N/A, Unknown

### **Housekeeping**

44. Is there a HEPA vacuum present?
- a. Yes
  - b. No
  - c. N/A, Unknown
45. On a scale of 1-5, how cluttered is the home?
- 1 = All Surfaces Clear
  - 2 = Most Surfaces Clear
  - 3 = Some Surfaces Clear
  - 4 = Most Surfaces Cluttered
  - 5 = All Surfaces Cluttered
46. Are there open food items and/or crumbs visible in the kitchen or living areas?
- a. Yes
  - b. No
  - c. N/A, Unknown
47. Is there evidence of doorway walk-off mats used?
- a. Yes
  - b. No
  - c. N/A, Unknown
48. Is there evidence that household members adhere to a “shoes-off” policy?
- a. Yes
  - b. No
  - c. N/A, Unknown
49. Is there evidence of weekly dusting in the home?
- a. Yes
  - b. No
  - c. N/A, Unknown

### **Smoking**

50. Do any household members smoke?
- a. Yes
  - b. No
  - c. N/A, Unknown
51. Is there evidence of smoking inside the home?
- a. Yes
  - b. No
  - c. N/A, Unknown



**APPENDIX C. WASHINGTON STATE INSTITUTIONAL REVIEW  
BOARD APPLICATION**



## APPENDIX C. WASHINGTON STATE INSTITUTIONAL REVIEW BOARD APPLICATION



Washington State Institutional Review Board (WSIRB)

### Application Instructions

- **Please call and discuss your study plans *prior* to completing this application in order to prevent avoidable delays or misunderstandings in the review of your application.** You may contact us at 360.902.8075 or at [wsirb@dshs.wa.gov](mailto:wsirb@dshs.wa.gov).
- **Prior to submitting this application, investigators who are requesting identifiable records from DSHS, DOH, L&I, and/or HCA should contact the Washington State agency data manager(s) to: 1) ascertain the feasibility of obtaining the desired dataset(s); and 2) to secure the Washington State agency data manager willingness to support the request (note that this approval does not authorize disclosure of the records).** Applications that qualify for expedited review do not require signatures for initial review; however, investigators must still contact the Washington State agency data manager as instructed above.
- Complete all applicable sections. All information requested in the application must be included in the application submitted for review. Do not respond to sections in the application by referring to other documents attached to the application.
- Investigators and all research staff who will have contact with human subjects and/or access to identifiable personal records must complete appropriate training in the protection of human subjects. Public Health Service-funded (NIH, CDC, SAMSA, AHRQ, IHS, HRSA) investigators and research staff must also complete financial conflicts of interest training. Study approval will not be extended until documentation of all required training has been provided. Visit our [website](#) for information on this training requirement.
- Consult the *Washington State Agency Policy on Protection of Human Research Subjects* for guidance on whether your proposal requires full Institutional Review Board (IRB) review or may qualify for expedited review. Additional information about procedures is found in the *Washington State Institutional Review Board Procedures Manual*. If you have questions, contact the Human Research Review Section.

**Expedited Review:** Applications that qualify for expedited review may be submitted at any time and generally will be reviewed within two weeks of receipt. Submit an electronic copy of the proposal to [wsirb@dshs.wa.gov](mailto:wsirb@dshs.wa.gov). **Signatures are not needed for the initial review.**

**Full IRB Review:** Applications that require full Board review are pre-reviewed before they are placed on a meeting agenda. Submit an electronic copy of the proposal to [wsirb@dshs.wa.gov](mailto:wsirb@dshs.wa.gov)

no later than the application deadline on the *Calendar of Review Board Meetings*. A Summary of Pre-Review Issues will generally be sent to investigators about a week after the application deadline. Investigators will have one week to make revisions in response to pre-review comments and then submit a revised electronic application and sufficient copies for full committee review. **Signatures are not needed for pre-review.**

- Signed original and copies: All initial reviews are conducted with an electronic application. After the initial review, investigators will be instructed to submit a signed original and the number of copies required for the final review.

Send paper copies of application to:  
*(Please submit loose double-sided  
sheets, collated, with rubber bands)*

Department of Social and Health Services  
Human Research Review Section  
1115 Washington Street SE  
PO Box 45205  
Olympia WA 98504-5205  
360.902.8075

## Definitions

**The following definitions apply to terms used in this application:**

**"Child"** means a person who has not attained the legal age for consent to treatments or procedures involved in the research, under the applicable law of the jurisdiction in which the research will be conducted.

**"De-identified records"** mean that all direct and indirect identifiers have been removed from individual-level records. De-identified records are not considered PHI or identifiable personal information. **Public use datasets** are comprised of de-identified records.

**"Direct identifiers"** in data or records include names; postal address information; telephone numbers; fax numbers; electronic mail addresses; social security numbers; medical record numbers; health plan beneficiary numbers; account numbers; certificate/license numbers; vehicle identifiers and serial numbers, including license plate numbers; device identifiers and serial numbers; web universal resource locators (URLs); internet protocol (IP) address numbers; biometric identifiers, including finger and voice prints; full face photographic images and any comparable images; and any other unique identifying number, characteristic, or code.

**"Human subject"** means a living individual about whom an investigator (whether professional or student) conducting research obtains (1) Data through intervention or interaction with the individual, or (2) Identifiable private information.

**"Identifiable"** data or records contain information that reveals or can likely be associated with the identity of the person or persons to whom the data or records pertain. Data or records with **direct identifiers** removed, but which retain **indirect identifiers**, are considered identifiable.

**"Indirect identifiers"** in data or records include geographic identifiers smaller than a State (city, county, and zip code, and their equivalent geocodes, except for the initial three digits of a zip code); all elements of dates (except year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death; and all ages over 89 and all elements of dates (including year) indicative of such age, except that such age and elements may be aggregated into a single category of age 90 or older.

**"Minimal Risk"** means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

**"Minimum Necessary"** means that the agency disclosing the protected health information or identifiable personal records must make reasonable efforts to limit the disclosure to the minimum necessary to accomplish the intended purpose of the use, disclosure, or request.

**"Non-identified records"** means that all direct identifiers have been removed from individual-level records, but the records may include dates related to an individual and geographic identifiers smaller than a State. Non-identified health records are considered protected health information and are identifiable. **Limited datasets** are comprised of non-identified records.

**"Protected Health Information (PHI)"** means individually identifiable health information created or received by a health care provider, health plan, or health care clearinghouse that is

transmitted or maintained in any form or medium.

**Abbreviations**

DSHS Washington State Department of Social and Health Services  
DOH Washington State Department of Health  
L&I Washington State Department of Labor and Industries  
HCA Washington State Health Care Authority





Washington State Institutional Review Board (WSIRB)

**Application for WSIRB Review**

WSIRB USE ONLY

**1. Project Identification**

**1.1 Project Title Weatherization Plus Health Study**

**1.2 Principal Investigator**

NAME <b>Bruce Tonn</b>		HIGHEST DEGREE(S) EARNED <b>Doctorate</b>
AGENCY OR ORGANIZATION NAME (AGENCY, UNIVERSITY, PROFESSIONAL ORGANIZATION, COMMERCIAL RESEARCH FIRM, ETC.) <b>Oak Ridge National Laboratory</b>		
COMPLETE MAILING ADDRESS <b>One Bethel Valley Rd, PO Box 2008, MS-6038</b>		
CITY <b>Oak Ridge</b>		STATE ZIP CODE <b>TN 37831</b>
OFFICE PHONE NUMBER <b>(865) 574-4041</b>	ALTERNATE PHONE NUMBER <b>(865) 574-8292</b>	EMAIL ADDRESS <b>tonnbe@ornl.gov</b>

1.3 **Research Abstract.** Provide a brief summary of the research **purpose and methods.**  
Please limit to this page.

**This project will estimate potential Medicaid cost savings benefits of the Opportunity Council's (Bellingham, WA) Weatherization Plus Health Program. This Program serves low-income households that report having minor children with asthma. The Program installs a comprehensive range of energy efficiency measures (funded by the U.S. Department of Energy) and measures designed to reduce asthma triggers (funded by a private donor). The literature indicates that the interventions adopted by the Program should result in reductions in asthma symptoms and episodes. The goal of this study is to determine if there are Medicaid cost savings attributable to the Program and if these savings are synergistic (i.e., that the savings attributable to the Program are more than savings that would have occurred from the installation of energy efficiency measures and asthma reduction measures separately). The project will contact households enrolled in the Program (approximately 35) and a similar number of control group homes located in a nearby community that only received energy efficiency measures. The project will be clearly explained to each household head. Each adult member of the household will be asked to sign an authorization for the disclosure of Medicaid records for themselves if they are an adult with asthma or as the legal guardian for a minor(s) in the home with asthma. Medicaid records related to asthma treatment will be collected going back one year before any energy efficiency and asthma trigger reduction measures were installed in the home to the present time. These records will indicate changes in the consumption of direct medical expenditures related to asthma including hospitalizations, emergency care, physicians' visits, prescription medications and equipment costs. Statistical methods will be applied to estimate the impacts of the Program on changes in asthma-related medical costs.**

1.4 **Anticipated Start Date: 11/01/2012 Anticipated End Date: 12/30/2013**

1.5 **Training**

Principal investigators, co-investigators, and all research staff who will have contact with human subjects and/or access to identifiable personal records must complete training in human subject protections every three years. A certificate of completion should be attached to each CV. HIPAA, Good Clinical Practice, or Responsible Conduct of Research training is *not* accepted in lieu of human subject protections training.

Name of most recent human subjects protection training: \_\_\_\_\_ Date  
completed: **10/30/2012**

**Protecting Human Research Training; NIH Office of Extramural Research**

Principal investigators who are not employees of DSHS, DOH, L&I, or HCA must complete and sign Appendix E: Unaffiliated Investigator Agreement, and submit it with the signed original application.

As **Principal Investigator**, I acknowledge that I am responsible for the submission of this application. I have fully reviewed the application forms and instructions and believe this

application is complete and accurate. I affirm that, if approved, this research will be conducted in compliance with WSIRB-approved procedures and requirements.

SIGNATURE	DATE

**1.6 Supervisor of Principal Investigator**

NAME <b>Joel Eisenberg</b>	TITLE <b>Research and Development Program Manager, Energy and Transportation Science Division</b>	
AGENCY OR ORGANIZATION NAME (AGENCY, UNIVERSITY, PROFESSIONAL ORGANIZATION, COMMERCIAL RESEARCH FIRM, ETC.) <b>Oak Ridge National Laboratory</b>		
SIGNATURE  E	DATE	EMAIL ADDRESS <b>eisenbergjf@ornl.gov</b>

**1.7 Co-Investigator (if any)**

NAME <b>Erin Rose</b>	HIGHEST DEGREE(S) EARNED <b>MSSW</b>	
AGENCY OR ORGANIZATION NAME (AGENCY, UNIVERSITY, PROFESSIONAL ORGANIZATION, COMMERCIAL RESEARCH FIRM, ETC.) <b>Oak Ridge National Laboratory</b>		
COMPLETE MAILING ADDRESS <b>One Bethel Valley Rd, PO Box 2008, MS-6038</b>		
CITY <b>Oak Ridge</b>	STATE <b>TN</b> ZIP CODE <b>37831</b>	
OFFICE PHONE	ALTERNATE	EMAIL ADDRESS

NUMBER <b>(865) 574-8292</b>	PHONE NUMBER <b>(865) 567-3822</b>	<b>roseem@ornl.gov</b>
---------------------------------	---------------------------------------	------------------------

Name of most recent human subjects protection training: \_\_\_\_\_ Date \_\_\_\_\_  
 completed: **8/23/12**

**Protecting Human Research Training; NIH Office of Extramural Research**

1.8 **Other Research Staff:** List all other research staff who will have contact with human subjects or access to identifiable personal records in Appendix A. Attach CVs or resumes for all research staff, including the PI and Co-PI, along with a certificate of completion of human subjects training and financial conflicts of interest training, as applicable, to Appendix A. CVs or resumes should not exceed five (5) pages per person.

1.9 **Student Research.** Applications submitted by students must also be approved by their academic advisor or chair of their committee.

NAME OF CHAIR OR ACADEMIC ADVISOR		HIGHEST DEGREE(S) EARNED
COLLEGE OR UNIVERSITY		
COMPLETE MAILING ADDRESS		
CITY		STATE ZIP CODE
OFFICE PHONE NUMBER	ALTERNATE PHONE NUMBER	EMAIL ADDRESS

As **Academic Advisor/Committee Chair** to the Student Investigator, I will provide oversight for this research. I have read and approved the research design and methods.

SIGNATURE OF ADVISOR/COMMITTEE CHAIR	DATE
--------------------------------------	------

1.10 **Person preparing this document** (if other than PI)

NAME <b>Erin Rose</b>	HIGHEST DEGREE(S) EARNED <b>MSSW</b>	EMAIL ADDRESS <b>roseem@ornl.gov</b>
ROLE IN PROJECT <b>Co-PI</b>		PHONE NUMBER <b>(865) 574-8292</b>

2. **Funding**

2.1 **Is this research funded by a grant, contract, cooperative agreement, or other award?**

No. Explain how costs of the proposed research will be supported:

Yes. Identify the agency or organization that received the award:

**Oak Ridge National Laboratory has a contract with the US Department of Energy to conduct a comprehensive national evaluation of the Weatherization Assistance Program. This national evaluation is comprised of a multitude of studies and tasks attempting to achieve both energy and non-energy impacts. This study is supported through this contract. It is not a grant and there are no comments from the funding source.**

TYPE OF FUNDING SOURCE(S) <input type="checkbox"/> Federal – HHS <input checked="" type="checkbox"/> Federal – other <input type="checkbox"/> State, local government <input type="checkbox"/> Private foundation  <input type="checkbox"/> Other (describe):	
FUNDING AGENCY(S) NAME <b>US Department of Energy</b>	CONTACT NAME <b>Jennifer Somers</b>
COMPLETE MAILING ADDRESS <b>Office of Weatherization and Intergovernmental Program U.S. Department of Energy Energy Efficiency and Renewable Energy 1000 Independence Ave, SW, Mail Stop EE-2K</b>	

CITY CODE	STATE	ZIP
Washington, DC	DC	20585
PHONE NUMBER	EMAIL ADDRESS	
(202) 287-1740	Jennifer.Somers@EE.Doe.Gov	

If this project is funded by an external agency and DSHS, DOH, L&I, or HCA is the grantee, attach a copy (double-sided) of the grant narrative to Appendix M.

2.2 **Research budget total: \$200,000                      Start Date 3/8/12    End Date 12/30/2013**

2.3 **List the major budget categories and dollar totals for each category.** If this is a multi-site study, include only the amount of the budget allocated to the study site described in this application.

**Study Design and Development of Instruments; \$35,000**

**Data Collection; \$45,000**

**Participant Incentive; \$14,000**

**Data Analysis and Report Writing; \$92,000**

**Indirect; \$14,000**

### 3. **Conflict of Interest**

Conflicts of interest can include financial and non-financial interests. **All individuals involved in the research that have responsibilities in the design, conduct, or reporting of the research (including consultants and student research staff) must complete and submit a copy of Appendix N: Conflict of Interest Reporting.**

### 4. **Requests for State Agency Records Information and/or Staff Resources**

If the research requires record information or resource contributions from DSHS, DOH, L&I, or HCA, **you must discuss your plans with the data manager or administrator responsible for the records or resources requested *before* preparing this application.** Complete and submit **Appendix G** and/or **Appendix H** to each data manager or administrator and obtain his/her signature(s) on the form to document their support for the research request. If identifiable DSHS and/or DOH records will be used or disclosed in electronic form, complete and submit **Appendix J** with your application.

**4.1 Does the research require use and/or disclosure of identifiable records or Protected Health Information (PHI) from DSHS, DOH, L&I, or HCA?**

- No; if no, skip to item 4.3.
- Yes; complete **Appendix G: Requests for Use or Disclosure of Records**. However, if the research is funded or conducted by the agency from which records are requested, Appendix G is not necessary.

**4.2 Will the identifiable records from DSHS, DOH and/or HCA be accessed or disclosed in electronic form?**

- No
- Yes; complete **Appendix J: Electronic Data Security Plan only if any of the research will be conducted outside of the State agency secure network**.

**4.3 Does the research require other resources from DSHS, DOH, L&I, or HCA (e.g., professional consultation, clerical services, facilities/equipment, and assistance in identifying /contacting subjects)?**

- No
- Yes; complete **Appendix H: Resource Requests**. However, if the research is funded or conducted by the agency from which records are requested, Appendix H is not necessary.

**5. Study Description**

Use lay language that can be understood by a person who is not familiar with your area of expertise. Do not refer to, or copy and paste from, a grant application or from the Research Abstract in Section 1.3 of this application.

**5.1 Purpose and Conceptual Rationale**

Describe the background and significance of this research. **The Department of Energy's Weatherization Assistance Program (WAP) serves households of low socioeconomic status in attempts to achieve energy efficiency through home energy retrofit and energy consumption education. The mission of WAP also involves addressing health and safety concerns as they relate to home energy. Households must be income eligible for the Program at 200% federal poverty level. It is the assumption that many of the households served by the Program also receive Medicaid or health care assistance. Currently, very few WAP agencies go beyond the required standard health and safety measures per DOE's WAP regulations notice. The Opportunity Council is a leader in the field of Weatherization Plus Health targeting asthma reduction measures in households with caregivers who have self-reported that children with asthma reside in the home. Medicaid records will be collected from the Washington State Health Care Authority to measure potential changes in costs related to asthma symptoms and episodes. This transfer of data involves the Opportunity Council requesting and receiving authorizations for the disclosure**

of Medicaid records from both treatment and comparisons groups, submitting the authorization forms to the Health Care Authority through a secure file transfer protocol and receiving asthma specific Medicaid records back from the Health Care Authority using the same secure file transfer protocol. The Opportunity Council has been tasked with this data collection effort and then with entering the data into a database for future analysis by Oak Ridge National Laboratory. The dataset will be de-identified of PII prior to ORNL reviewing the data. This is to reduce the risk of breach of confidentiality by limiting the number of times the PII is transferred and by the number of persons with access to the data. Records will be requested that have asthma related Medicaid cost codes from the time of the request back to January 2008. The minimum data elements will be requested. If the research suggests a relationship between weatherization plus health measures and a decrease in direct medical expenditures related to asthma as evidenced through the disclosure of records, the argument for funding these Programs can continue to be made and the pool of stakeholders can expand offering this vulnerable population of low-socioeconomic status opportunities to more effectively manage asthma by reducing environmental exposure to triggers.

Specify the questions this research will attempt to address. **The research will seek to answer the following questions: 1. Does the Opportunity Council's Weatherization Plus Health program result in decreased direct medical expenditures related to asthma treatment? 2. Do the direct medical expenditures also correlate with self-reported and caregiver reported improvement in health related asthma symptoms and episodes? 3. Does the level of impact on direct medical expenditures correlate with specific weatherization or asthma reduction measures provided through Weatherization Plus Health? 4. By linking the Medicaid or health care assistance records and school attendance, academic and nursing care records is a relationship observed between the Weatherization Plus Health program, asthma episodes and treatment needs, and school attendance and on-site care? 5. If a relationship is observed, what are the cost savings related to the decrease in direct medical expenditures, increased school attendance, performance, and on-site care, and caregiver productivity? How do the physicians attribute change in asthma status and episodes per physician records and report? Are there any adults in the household that self-report a change in asthma conditions as a benefit for treating the home for the children?**

Include a brief summary of the pertinent literature with full citations, if applicable.

**Significant literature exists on the costs to families with asthma and the benefits of household improvements on asthma symptoms and frequency of episodes (Breyse, et al. 2002; Wu & Takaro 2007; Jacobs, et al. 2007). Asthma is the most chronic pediatric disease in the US affecting 9.5 percent of children while disproportionately affecting minority and low-income children (Brim, et al, 2008; CDC 2012). Annual mean health care expenditures for children with asthma is 2.8 times higher than children without asthma, \$1129 vs. \$468 (Lozano et al., 1999). Annual costs associated with asthma and respiratory illness and benefits from relieving symptoms in the US range between \$2 billion and \$19.7 billion (Corso & Fertig, 2008; Landigran et al. 2002).**

**There is significant evidence of a causal relationship between indoor air contaminants**



and poor health (Crain, et al., 2002; NCHH & ERT Associates, 2006; NIEHS, 2011; The Opportunity Council, et al., 2004; Wu & Takaro, 2007). In several analyses of impacts of multi-attribute interventions including housing interventions targeting reductions of asthma triggers such as installation of ventilation systems, measures to reduce mold, and integrated pest management, a positive correlation was found between such measures and reduced medical costs (Kattan, et al., 2005; Krieger, et al., 2005; Ngugen, et al., 2010; Nurmagambetov, et al., 2011). In these studies, the range of direct medical costs averted for children with asthma per year was \$124 -\$555; along with a corresponding increase in symptom-free days per year between 20.8-37.8 days. However, there are no known research studies specifically analyzing the impact of combining weatherization measures and asthma reduction measures on Medicaid costs associated with the treatment of asthma.

**Citations:**

Breyse, P., Farr, N., Galke, W., Lanphear, B., Morley, R., et al.(2004). The Relationship between Housing and Health: Children at Risk. *Environmental Health Perspectives*, 112(15).

Brim, S. N., Rudd, R. A., Funk, R. H. & Callahan, D. B. (2008). Asthma prevalence among US children in underrepresented minority populations: American Indian/Alaska Native, Chinese, Filipino, and Asian. *Pediatrics*, 122, 217-222.

Centers for Disease Control and Prevention's National Asthma Control Program. (2012). *Asthma in Washington*. Washington, DC.

Corso, P. & Fertig, A. (2008). The long-term economic costs of asthma. *Partnership for America's Economic Success*, 13: 1-12

Crain, E.F. et al. (2002). Home and allergic characteristics of children with asthma in seven U.S. urban communities and design of an environmental intervention: The inner-city asthma study. *Environmental Health Perspectives*, 110(9), 939.

Jacobs, D.E., Kelly, T. & Sobolewski, J. (2007). Linking public health, housing, and indoor environmental policy: Successes and challenges at local and federal agencies in the United States. *Environmental Health Perspectives*, 115(6), 976.

Kattan M., Stearns S., Crain E., Stout J., Gergen P. & Evans R. (2005). Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. *Journal of Allergy Clinical Immunology*, 116(5):1058–1063.

Krieger J.W., Takaro T.K., Song L. & Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. *American Journal of Public Health*, 95:652–659.

Landrigan P.J., Schecter C.B., Lipton J.M., Fahs M.C. & Schwartz J. (2002). Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer and developmental disabilities. *Environmental Health Perspectives* 110:721–728.

**Lozano P., Sullivan S.D., Smith D.H. & Weiss K.B. (1999). The economic burden of asthma in US children: estimates from the National Medical Expenditure Survey. Journal of Allergy and Clinical Immunology. Nov;104(5):957-63.**

**National Center for Healthy Housing & ERT Associates. (2006). Asthma and weatherization in Maine.**

**National Institute of Environmental Health Services. (2011). Asthma and its Environmental Triggers. Washington, DC.**

**National Renewable Energy Laboratory. (2011). Healthy Housing Opportunities During Weatherization Work.**

**Ngugen, K. H., Boulay, E. & Peng, J. (2010). Quality-of-life and cost-benefit analysis of a home environment assessment program in connecticut. Journal of Asthma, 1-9.**

**Nurmagambetov, T. A. et al. (2011). Economic value of home-based, multi-trigger, multicomponent intervention with an environmental focus on reducing asthma morbidity; A community guide to systematic review. American Journal of Preventative Medicine, 41(251), 533-547.**

**The Opportunity Council & Erin Hamernyik, Ellen Tohn, ERT Associates & Eric Oetjen, ICF Consulting. (2004). Weatherization plus health; Program materials and protocols to integrate health concerns in to wx projects.**

**Walter, M. J. et al. (2008). Predicting worsening asthma control following the common cold. European Respiratory Journal, 32(6), 1548-1554.**

**Wu, F. & Takaro, T.K. (2007). Childhood asthma and environmental interventions. Environmental Health Perspectives, 115(6), 971.**

**Yawn, B.P. (2008). Factors accounting for asthma variability: achieving optimal symptom control for individual patients. Primary Care Respiratory Journal, 17(3), 138-147.**

If this is evaluation research, briefly describe the program or intervention being evaluated. **The Opportunity Council's Weatherization Plus Health program provides free education, tools and home improvements to help reduce asthma triggers for children in addition to weatherization measures completed in these income-eligible households in Whatcom, San Juan and Island counties. Weatherization is the process of making a home more energy efficient through targeted measures based on a home energy assessment. Outside of this specific study, ORNL has been tasked with determining health impacts from weatherization work completed in the home. In addition to the potential energy and non-energy impacts a household might observe from weatherization only, this study will measure the impact of the individualized package of asthma reduction measures study participants receive through the Opportunity Council's Plus Health add on to the program. These targeted asthma reductions include: improved mechanical ventilation for moisture and mold control, dust mite covers for mattresses and pillows, hard-surfaced flooring to replace carpeting in bedrooms and main living areas, integrated pest management, walk off mats for entrances to the home, the supply of natural cleaning**

**products, and education on the effects of exposure to environmental tobacco smoke.**

## 5.2 Study Design

State the primary hypotheses or objectives of this research. **The hypothesis is that Weatherization Plus Health leads to a decrease in asthma symptoms and episodes in children of program eligible households, which therefore leads to a reduction in treatment needs while in the home, during the school day and from medical professionals. The objective is to explore a range of impacts of the Program through the collection of asthma related direct medical expenditures records, physicians records, school records and self reports of household members to share with potential stakeholders of the Program.**

Indicate whether the design will involve randomization, and/or whether comparison or control groups will be used. **As this is a retrospective exploratory study researching the impact the program has had on a purposively selected cohort of study participants, it does not involve randomized controlled experimental design. Households who qualified and received asthma reduction measures in addition to weatherization through WAP will be the treatment group and households with the same eligibility criteria who would have qualified for the program if the program existed in their community will serve as the comparison group.**

Describe the sampling plan, the size of the sample or study group(s), and the power of the planned statistical tests, if applicable. **There will be approximately 70 households involved in the study. This project will collect data for all homes (approximately 35) that received both weatherization measures and asthma reduction measures from the Opportunity Council. A comparison group of 35 homes will be randomly selected from a list of weatherized homes provided by a nearby local agency that provides low-income weatherization services. Each comparison group household will have at least one child who has asthma. None of the comparison group homes will have received asthma reduction measures.**

Specify the major independent, dependent, and extraneous variables, and discuss possible threats to internal and/or external validity. **The major independent variables are: weatherization measures installed in the home, asthma reduction measures installed in the home, and standard demographic descriptors for household members (age, gender). The major dependent variables are: annual asthma-related direct medical expenditures per person and household; self-reported frequency of asthma-related symptoms and episodes per person; missed days or hours at school for each school-aged child in the study; academic performance for each school-aged child in the study; and self-reported loss of adult productivity related to work both inside and outside of the home. Possible threats to internal validity include: differences in standard weatherization measures installed by the Opportunity Council and the local agency that weatherized the comparison homes; and changes in the effectiveness in asthma treatments over time. Choosing a nearby local agency from the same region and climate zone as the Opportunity Council addresses the first issue. Having a comparison group addresses the second. With respect to external validity, this project is considered to be exploratory research. There is no intention for the**

**results of this research to be generalized beyond the study population.**

Describe the statistical tests, if any, that will be used and explain how the expected results will address the hypotheses or research objectives. **An analysis of variance (ANOVA) will be used to test whether there are statistical differences between the treatment and comparison group populations over the major dependent variables. Multiple regression analysis will be used to test the significance of the major independent variables upon the major dependent variables, while controlling for the major demographic variables.**

### 5.3 Data Collection Procedures

a. **Does the research involve contact with human subjects?**

No **Go to item 5.3b.**

Yes Explain all of the following:

- what subjects will be asked to do:
- who will perform the data collection procedures:
- where data collection procedures will be performed:
- when or how often data collection procedures will be conducted:

b. **Does the research involve use of identifiable records?**

No **Go to item 5.3c.**

Yes Explain all of the following:

- the agency holding each source of identifiable records or PHI: **The Health Care Authority**
- how each source of records will be obtained: **Records from HCA will be requested in electronic format through a secure FTP site. Complete authorizations forms signed by consenting subjects will be sent through the secure FTP site to the HCA. The Provider One IDs obtained by the subject and entered into the authorization forms will be used to identify the subject in the HCA database. The Provider One ID on the Medicaid records will be used to identify the subject upon HCA transfer of data to the Opportunity Council through the same secure FTP site. HCA will not remove identifiers prior to the disclosure of records back to the researchers at the Opportunity Council. Records will not be sent to researchers to Oak Ridge National Laboratory by HCA or by the Opportunity Council. The Opportunity Council will enter the data into a database. Data will be de-identified of PII and replaced with study codes. All explicit identifiers (subject name, parent or guardian name(s), address, telephone number(s), date of birth, social security number, HCA Provider One ID, Opportunity Council client identification number, school name, physician name and address, school name, address and grade level) will be removed. All additional data values will be generalized- range of dates will be used in**

place of exact Opportunity Council Weatherization Plus Health visits, medical treatment dates, and attendance dates. Oak Ridge National Laboratory will conduct analysis through the de-identified database. Oak Ridge National Laboratory does not have access to identifiable primary research data for the Weatherization Plus Health study data to be linked to. Identified PHI and PII will not be shared on any subject outside of the project team.

- plans to link records from multiple sources and the sequence of linkage, if applicable: **The HCA records will be linked to the home asthma reduction interventions completed by the Opportunity Council who keeps this data in-house; weatherization measures completed by the Opportunity Council and the Snohomish County Community Action Partnership, both of which keep this data in-house; physician records will be requested from the physician office to review physician treatment notes and recommendations; school records (as applicable) to be obtained through the individual school or the central office serving that school to explore changes in attendance and use of on-site medical personnel for asthma related incidences; survey and questionnaire responses collected by the Opportunity Council to determine present day asthma and health status, and in home observations completed by the Opportunity Council to examine current status of observable asthma triggers in the home. These data will be entered into a database managed by the Opportunity Council. Upon the database being de-identified of PII and protected health information, and replaced with study codes, the database will be shared with Oak Ridge National Laboratory for analysis.**
- the identifiers to be used to link multiple records sources, if applicable: **The direct identifiers used to link the multiple records will be the subject and parent or guardian of subject's name, date of birth, address, phone number, social security number, and Provider One ID for HCA.**

c. **Does the research involve multiple data collection periods?**

No **Go to item 5.3d.**

Yes Explain the following:

- the number of data collection intervals:
- the time period between data collection intervals:
- the data collection methods to be used at each interval:

d. **Will the study take place in clinics, hospitals, welfare offices, jails, or other facilities?**

No **Go to item 5.4.**

Yes Attach a copy of letters of cooperation from each facility to **Appendix L.**

#### 5.4 Data Collection Instruments

List all data collection instruments, including questionnaires, interview guides, assessments or tests, focus group guides, record review forms, etc. Attach copies of all data collection instruments to **Appendix K**. If none, skip to Section 6.

**There are no data collection instruments used as part of the records only research component of this study. All data collection instruments used to complete tasks associated with other components of this study not reviewed by WSIRB will not reference WSIRB. However, the data collection instruments have been included in Appendix K to provide documentation of the primary research data collected to be combined with the records only research data for analytic purposes.**

#### 6. Study Subjects

**6.1 Expected number of subjects over the course of the research: A total of 70 households will be included in the study. The number of record requests from HCA is difficult to determine as we will need to identify household members with asthma at the time of recruitment. We anticipate collecting records for approximately 70 individual cases for the treatment group (with an observed average of 2 children with asthma per household) and will attempt to enroll 35 individual cases for the comparison group. We therefore expect approximately 105 individual subjects to be enrolled in the study over the course of the research.**

##### 6.2 Specify inclusion criteria for subjects.

**To be included in the treatment group, subjects must have participated in the Weatherization Plus Health program between calendar years 2009 and 2012, must have a diagnosis of asthma by a medical professional, must be residing in the same residence where the asthma reduction measures and interventions were conducted, and must have lived in the residence for one year prior to the Weatherization Plus Health interventions. Each adult with asthma living in the household must be willing to provide consent for the authorization of the disclosure of Medicaid records related to asthma treatment for themselves or as guardians for minors with asthma living in the home.**

**To be included in the comparison group, subjects must have received services through the Weatherization Assistance Program (WAP) in Snohomish County between calendar years 2009 and 2012, and must have a child residing in the home diagnosed with asthma by a medical professional, that was living in the home one year prior to the WAP intervention. Each adult with asthma living in the household must be willing to provide consent for the authorization of the disclosure of Medicaid records related to asthma treatment for themselves or as guardians for minors with asthma living in the home.**

##### 6.3 Specify exclusion criteria for subjects.

**Subjects in the treatment group will be excluded if they are no longer residing in the**

residence where the Weatherization Plus Health interventions occurred. Subjects will be excluded if they have not been diagnosed with asthma by a medical professional. Children in the home with asthma will be excluded if they were not born one year prior to the Weatherization Plus Health intervention. Adults in the home with asthma will be excluded if they were not residing in the home one year pre-intervention. Subjects will be excluded from the study if they are unwilling or incapable of consenting to the authorization of the disclosure of Medicaid records related to their asthma, or if their legal guardians are unwilling or incapable of consenting to the authorization of the disclosure of Medicaid records related to their asthma.

Subjects in the comparison group will be excluded if they are no longer residing in the residence where the Weatherization Assistance Program interventions occurred. Subjects will be excluded if they have not been diagnosed with asthma by a medical professional. Children in the home with asthma will be excluded if they were not born one year prior to the WAP intervention. Adults in the home with asthma will be excluded if they were not residing in the home one year pre-intervention. Subjects will be excluded from the study if they are unwilling or incapable of consenting to the authorization of the disclosure of Medicaid records related to their asthma, or if their legal guardians are unwilling or incapable of consenting to the authorization of the disclosure of Medicaid records related to their asthma.

6.4 Will individuals of either gender be excluded?

No

Yes Explain why the research focuses on one gender:

6.5 Is the research limited to specific age group(s)?

No

Yes Specify the age group(s) and explain why the research focuses on them:

6.6 Will individuals be eligible for the research if they are not proficient in English?

Not applicable -- records-only research.

Yes. Describe plans for translating or interpreting recruitment materials, scripts, consent forms, and data collection instruments. Identify who will translate study documents and indicate if all translators are certified. (Translations of Board-approved materials must be submitted after study approval.)

- No. Provide a methodological or scientific rationale for exclusion:

### 6.7 Vulnerable subject groups

Vulnerable subjects may be the focus of the research or may be recruited incidentally. For example, if women of reproductive age would be eligible for the research, Appendix B should be completed.

**Check all that apply:**

- Pregnant women/human fetuses/neonates (complete **Appendix B**)
- Prisoners (complete **Appendix C**)
- Children (complete **Appendix D**)
- Developmentally disabled
- Dementia/cognitively impaired
- Mentally/behaviorally/emotionally impaired
- Socially/economically disadvantaged
- Low literacy/educationally disadvantaged
- Seniors, over 65
- Seriously/chronically ill
- Substance users/abusers
- Undocumented immigrants
- Other (describe):

### 7. Risks and Benefits

**This Section must be completed for all research.**

The federal definition of "minimal risk" states that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.



7.1 **This research is (check one box):**

- Minimal risk
- More than minimal risk

Explain why this research is minimal risk *or* more than minimal risk **in relation to the above definition of minimal risk**. Provide examples of how research procedures are consistent with the level of risk checked above.

**Subjects in both treatment and comparison groups are asked to authorize the release of Medicaid records related to their asthma or a minor's asthma. Adequate protections will be implemented so that risks related to invasion of privacy and breach of confidentiality will be no greater than minimal. Asthma as a medical condition is generally not considered to be of a sensitive nature placing subjects at risk of criminal, or civil liability or considered to be damaging to the subject if there was a breach of confidentiality. To reduce risk of breach of confidentiality, the transfer of PHI will occur between the source of the data, being the Health Care Authority, and the Opportunity Council through a secure file transfer protocol; Only the minimum data elements necessary will be requested from the HCA; Subjects' PHI will be entered into a database and will then be de-identified of PII, and replaced with study codes. Identified PHI and PII will not be shared on any subject outside of the project team and will be destroyed by 9/30/14 with a permanent deletion of data from the file server.**

7.2 **Does the research involve any of these possible harms and/or discomforts to subjects?** Check all that apply.

- Invasion of privacy or breach of confidentiality
- Psychological/emotional discomfort or distress
- Social stigmatization
- Legal repercussions
- Economic (e.g., employment, insurability)
- Physical harm or discomfort
- Withholding standard care or procedures
- Significant time or inconvenience
- Other (describe):

7.3 **Describe each possible harm and/or discomfort checked above, the probability of the harm occurring and the magnitude of the harm if it does occur.**

**If there is a breach of confidentiality then PII and PHI could be released. However, the**

safeguards are in place through a data security plan, and training has been conducted for all staff who will have contact with the subjects. The PHI collected is related to direct Medicaid medical expenditures for asthma related costs only, which is typically not a condition placing an individual at risk for civil or criminal liability or damaging socially. The social stigmatization could be if the subjects are identified (outside of the research team) as a recipient of the Medicaid program.

**7.4 Describe what steps will be taken to minimize each of the possible harms and/or discomforts to subjects.**

To address the potential for invasion of privacy or breach of confidentiality and the potential for social stigmatization a data security plan is in place. A one time transfer of Protected Health Information (PHI) will occur between the data source (HCA) and the Opportunity Council. Medicaid records will be stored in a secure database per the data security plan. PHI will not be transferred outside of the Opportunity Council. Records will be de-identified of PII and replaced with study codes for each subject in a manner that upon all direct and indirect identifiers being removed, re-identification of those subjects will be highly improbable. In addition to removing explicit identifiers such as names and Provider One ID, additional data values will be suppressed, or generalized, or perturbed to further reduce the risk for indirect identification.

**7.5 If this research involves interactions or interventions with human subjects, describe what steps will be taken if subjects experience serious distress, discomfort, or decompensation during study participation.** Indicate whether a resource list or referrals will be available to give to subjects routinely or as needed, and attach the list to **Appendix L**. (If this is records research only, indicate “NA.”)

NA

**7.6 Describe any anticipated benefits for individual subjects who are participating or whose records are being used in this research.** If none, indicate “None.”

None

**7.7 Describe how this research will benefit this class of subjects or how it will contribute to general knowledge.**

This research seeks to identify relationships between the weatherization and asthma reduction measures provided to households of low socioeconomic status who may not have been able to afford the provided measures on their own and their impact on subject health. If a relationship is established between the measures and direct medical expenditures then programs offering this suite of services are better positioned for seeking and securing leveraged resources to fund their services and will be able to reach more households in need.

**7.8 Explain how the anticipated benefits of this research outweigh the harms and/or**

**discomforts.**

**The literature suggests that asthma can be controlled both through medical treatment, and education, as well as through interventions addressing environmental triggers. This research seeks to examine changes in direct medical expenditures related to asthma treatment pre and post in-home intervention. If a relationship is established, the research could provide further understanding of environmental asthma triggers, and could provide evidence to encourage stakeholders and private donors to contribute additional funding for these in-home interventions with the goal of reducing asthma symptoms and episodes. Due to the systems in place to protect subjects' privacy and to reduce breach of confidentiality, the benefits of this research to both individual subjects within the sample and the class of subjects outside the sample outweigh the potential of breach of confidentiality.**

**8. Use and/or Disclosure of Identifiable Records or PHI**

**8.1 Does this research involve use or disclosure of identifiable records or PHI?**

No **Go to Section 9.**

Yes If identifiable records are requested from DSHS, DOH, L&I, and/or HCA, complete **Appendix G.**

**8.2 Will signed authorization be obtained from study subjects and/or their parents/guardians for the use or disclosure of their identifiable records or PHI?**

No

Yes Explain how, when, and where signed authorization will be obtained and complete **Appendix F.**

**Subjects will be requested to sign the authorization during an on-site visit to the subject's home with trained Opportunity Council staff.**

**8.3 Are you requesting a waiver of authorization for use or disclosure of existing identifiable records or PHI?**

No

Yes Complete **Appendix I, Section 4 (all items).**

**9. Confidentiality**

Direct identifiers include name, address, phone, email address, Social Security Number, client identifier, medical record numbers, account numbers, PICCODE, license numbers, etc.

**9.1 Will names and other direct identifiers of study subjects be accessed or obtained for**

**any purpose (e.g., screening, recruitment, analyses)?**

No **Go to item 9.5.**

Yes List the direct identifiers to be collected and explain why they are needed for the research.

**Names, date of births, addresses, phone numbers, social security numbers and HCA Provider One IDs will be collected in order to ensure we are requesting and linking accurate information to the subject and have all necessary information for completion of authorization forms.**

**9.2 Will names and all direct identifiers be removed or segregated from research records and replaced with study codes as early in the process as possible?**

NA All records are non-identified.

Yes

No Explain your answer.

**9.3 Will a link between direct identifiers and study code numbers be retained until the research is completed?**

NA All records are non-identified.

No Specify when the link between identifiers and code numbers will permanently destroyed.

Yes Explain why it is necessary to retain the link between study codes and direct identifiers.

**As researchers working with a vulnerable population, it is our responsibility to disseminate our findings to the population being studied. The direct identifiers will also allow us to follow up with households on questions the data might generate.**

**9.4 Specify when all direct identifiers will be permanently separated from study records and destroyed.** (See Definitions on pg. 2 of the application.) If all records are non-identified, indicate "NA."

**9/30/14**

**9.5 Will identifiable research records be disclosed to anyone who is not involved with this research?**

No

Yes Describe the data to be disclosed, to whom, and the purpose of each disclosure.

9.6 **Will identifiable research records be used for a future study?**

No

Yes Explain your answer.

9.7 **Will a public-use/de-identified dataset be made available at the completion of the research?** (See Application Definitions.)

No

Yes **Note: a file layout of all data elements must be submitted for WSIRB review prior to release.** Explain how a public use dataset will be created.

9.8 **Will any identifiable research data or the study consent form be placed in a subject's medical record or case file?**

No

Yes Explain your answer.

9.9 **Will a federal Certificate of Confidentiality be requested?**

No

Yes, from (agency/name).

**For records-only research, skip Sections 10 and 11.  
Go to item 12.1 and complete all relevant Appendices.**

## 10. Mandatory Reporting

*Washington State Agency Policy* requires reporting of all suspected abuse/neglect of children and vulnerable adults, and reporting of threats of harm to self (suicidal ideation) or others. Some research involves diagnostic testing or clinical care, such that reporting of health conditions is

required. **Mandatory reporting requirements must be described in study consent/assent forms as exceptions to confidentiality.**

**10.1 Could interventions or interactions with subjects produce information that may lead to suspicion of abuse/neglect of a child? (RCW 26.44)**

No

Yes Describe plans for reporting such incidents to Child Protective Services.

**10.2 Could interventions or interactions with subjects produce information that may lead to suspicion of abuse/neglect of a vulnerable adult? (RCW 70.124, RCW 74.34)**

No

Yes Describe plans for reporting such incidents to Adult Protective Services or, in the case of state hospital patients, to hospital staff.

**10.3 Could interventions or interactions with subjects produce information that may lead to concern about threats of suicide or harm to other persons?**

No

Yes Describe plans for reporting such incidents and plans to be implemented in the event of imminent threat of harm.

**10.4 Will study procedures involve testing or diagnosis of any disease or condition that is reportable under WAC 246-101? (Such as notifiable diseases, blood lead levels, etc.)**

No

Yes Include a statement in the study consent form that the subject's condition will be reported to the state or local health department, as applicable.

## **11. Subject Recruitment**

**11.1 Explain how potential subjects will be identified.** Explain each method to be used to identify them (e.g., agency records, databases, referrals, advertisements, etc.).

11.2 **Does this research involve recruiting subjects who are minors or dependent adults?**

No

Yes Explain how, when, and where a parent or legal guardian will be contacted and asked for permission to recruit the minor or dependent adult. (If a waiver of parental/guardian permission will be requested, complete **Appendix I, Section 3.**)

11.3 **Explain how subjects will be recruited.**

11.4 **Explain when recruitment will occur.**

11.5 **Explain where potential subjects will be recruited.**

11.6 **Explain who will make initial research contact with potential subjects.** (If confidential state agency records will be used to identify potential subjects, the state agency must make initial contact.)

11.7 **Explain how privacy will be respected during the recruitment process.**

11.8 **Explain what steps will be taken to minimize undue influence to participate.**

11.9 **Will potential subjects be offered gifts, payments, services without charge, or other incentives to participate?**

No

Yes Specify the type of incentive, the monetary value, and when incentive(s) will be given.

**12. Informed Consent/Assent Process** Unless specific requirements are met and the WSIRB approves a waiver, signed consent/assent and signed parent/guardian permission for the participation of a child are required for studies that involve interventions or interactions with human subjects.

**12.1 Are you requesting a waiver of:**

- Documentation of consent/assent for study participation?  
 No    Yes (Complete **Section 1.1 or Section 1.2 of Appendix I**).
- Some or all required elements of consent/assent?  
 No    Yes (Complete **Section 2 of Appendix I**).
- Parent/guardian permission for study participation of a child?  
 No    Yes (Complete **Section 3 of Appendix I**).
- Waiver of authorization for use/disclosure of identifiable records or PHI?  
 No    Yes (Complete **all items in Section 4 of Appendix I**).

**If you are not contacting subjects, skip the remainder of Section 12.**

**12.2 Identify who will obtain consent, assent, or parent/guardian permission.** Provide job titles/credentials, and a description of consent training for all individuals responsible for obtaining consent:

**12.3 Describe how, when, and where consent, assent, and/or parent/guardian permission will be obtained.**

**12.4 Explain how subjects' understanding of the research procedures and the risks and benefits of study participation will be assessed.**

**12.5 Will an impartial witness be present during the consent/assent session?**

No

Yes Identify the individual who will serve as a witness and describe his/her qualifications.



**12.6 Complete Appendix F: Recruitment, Consent/Assent, and Authorization Documents.**  
Put the document title in a footer on each document. List all documents and readability scores in Appendix F and attach them to the Appendix. Names of electronic documents should match the document titles listed in this Appendix.

### **Application Checklist**

**The following documents must be submitted with the application, when applicable.**

- Appendix A: Additional Research Staff - attach CVs/resumes (limit to five pages each)
- Appendix B: Research Involving Pregnant Women, Human Fetuses, and Neonates as Subjects
- Appendix C: Research Involving Prisoners as Subjects
- Appendix D: Research Involving Children as Subjects
- Appendix E: Unaffiliated Investigator Agreement (Send with signed original only.)
- Appendix F: Recruitment, Consent/Assent, and Authorization Documents
- Appendix G: Requests for Use or Disclosure of Records
- Appendix H: Resource Requests
- Appendix I: Consent/Authorization Waivers
- Appendix J: Electronic Data Security Plan
- Appendix K: Data Collection Instruments
- Appendix L: Miscellaneous Study Documents
- Appendix M: Application for Funds Awarded to DSHS, DOH, L&I, and/or HCA (one copy double-sided)
- Appendix N: Conflict of Interest Reporting – **Required for all applications.**

**Submission of an incomplete application is a common cause for delay in the review of proposals.**