

Washington State
Weatherization Plus Health Program Pilot

**Pierce County
Healthy Homes Case Study**

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Pierce County Healthy Homes (PCHH) Partnership – with Weatherization Plus Health (Wx+H) program funding – delivered integrated healthy homes services including Community Health Worker (CHW) engagement and home visits, energy efficiency and healthy homes upgrades to 53 low income households with 78 occupants with respiratory health concerns – such as asthma and Chronic Obstructive Pulmonary Disease (COPD). As highlighted in the sidebar, initial results show promising success in encouraging action and improving the health and quality of life of clients with respiratory disease.

PCHH is a partnership comprised of Pierce County Human Services (PCHS) and the Tacoma-Pierce County Health Department (Health Department). PCHS is one of eight local public weatherization agencies in the State of Washington to receive an Enhanced Wx+H Grant in 2016. The Wx+H Program – funded by the State of Washington Energy Matchmaker Program – supports pilot projects to develop, test, and deploy new measures, to integrate investments in energy efficiency and health for low-income households with education and services.¹

Background

Before receiving Wx+H funds, the PCHH partnership existed as an extension of a decade-long collaboration between PCHS and the [Clean Air for Kids Partnership](#) (CAFK – led by the Health Department) to offer holistic, integrated services, in addition to weatherization and minor home repair, to improve asthma control and quality of life, while reducing energy costs.

Originally, Wx+H funding was intended to supplement the CAFK staffing resources. However, the CAFK public health funding drastically decreased just as the Wx+H program was beginning. Wx+H funding was important in allowing the Health Department to continue offering asthma home visits. The focus of the initiative shifted to integrating the CAFK referral network and asthma home visits with PCHS existing weatherization and home repair programs. While the CAFK focus was on children with asthma, the new partnership between PCHS and the Health Department expanded to serve all ages with respiratory disease – including adults with asthma or COPD.

Initial Promising Health Impacts

Taking Action: 86% of households getting follow-up home assessments reported taking two or more actions to reduce environmental triggers or improve medical management

Respiratory Control: 65% reported improvement (47% reported a significant improvement in ACT scores). The percentage of those with respiratory conditions under control increased from 42% to 67%

Quality of Life: 70% reported an improvement in Quality of Life as measured by AQLQ and CCQ (38% of improvements were significant)

Fewer Medical Visits: One year after initial services were provided, study participants reported four fewer Urgent Care visits, fifteen fewer Emergency Room visits and six fewer hospital admissions

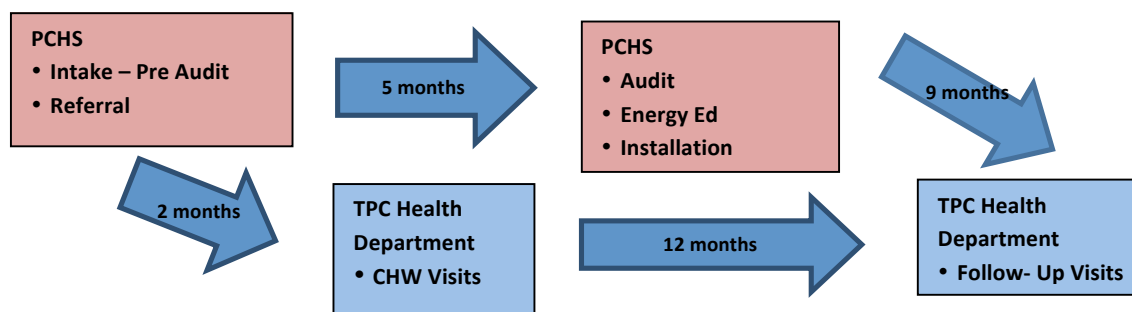
¹ See The [Washington State Weatherization Plus Health Pilot: Implementation and Lessons Learned](http://www.energy.wsu.edu/documents/WxHSummaryReport.pdf) (2018) for a complete discussion.

Program and Service Delivery Model

The initial strategy of relying heavily on Health Department CHWs for referrals and pre-qualification was adjusted to focus on existing PCHS clients – especially those receiving weatherization, energy assistance, and Early Childhood Education and Assistance Program (Head Start) services. This was supplemented by joint outreach events and work with clinics serving low-income households.

PCHS initiated the process with a pre-audit screening visit to homes of all referrals during which PCHS assessed likely eligibility for, and interest in, Wx+H services. The initial visit included a walk-through for a healthy homes assessment, information on weatherization services, and discussion of environmental triggers and air quality in the home. On completion of the pre-audit, PCHS referred potential Wx+H clients to CHWs. The CHW then provided one to three home visits focused on asthma or respiratory health management, comprehensive assessment of other needs, and development of an action plan. If clients had not already applied for Wx+H services, a CHW assisted with the application. As illustrated in Figure 1, weatherization and CHW services were delivered concurrently. During the grant period Health Department and PCHS outreach and auditing staff met weekly to share information and coordinate services. These informal systems were very helpful in the absence of established systems to share information on weatherization project and CHW service status and schedules².

Figure 1. Key Steps in the Process and Average Months Elapsed Between Each Phase



On average, five months (range 1 to 14 months) elapsed between CHW assessments and completion of weatherization healthy homes installation work. This was longer than expected and created challenges for maintaining client engagement during contracting and installation.

² See [Pierce County Healthy Homes Weatherization Plus Health Grantee Profile](http://www.energy.wsu.edu/documents/WxHEnhancedProfilePierce_12-20-17.pdf) for more details on the program http://www.energy.wsu.edu/documents/WxHEnhancedProfilePierce_12-20-17.pdf

Table 1. Services Offered by PCHS and its Partners

Service	Pierce County Human Services	Tacoma-Pierce County Health Dept.	Puget Sound Asthma Coalition Partners
Outreach and referrals	X	x	x
Intake – screening, qualification	X	x	
Initial Healthy Homes Assessment	X	x	
Energy audit/assessment	X		
Service coordination	X	X	
Medical support and management		X	X
Weatherization	X		
Healthy homes measures	X	x	
Client education/follow-up	X	X	
Additional services (repair, social)	X	x	X

LEAD = X, Support = x, *Green shading indicates new partner or existing partner in a new role*

CHWs were expected to follow-up with clients in person or by phone at three, nine and twelve months after the contracted work was completed. Follow-up contacts included action plan review, case management services, and data collection on health conditions and needs. Due to a nine-month gap in funding³, most three and nine month follow-up visits were not completed. When funding was restored, the Health Department focused on completing at least one follow-up home visit or call to each household in the nine to twelve month period after final measure installation. Households with follow-ups at less than six months were excluded from the analysis.

Client and Project Profiles

PCHS provided Wx+H measures and services to 53 households with 78 persons with respiratory conditions. Of these, 40 received comprehensive weatherization and/or healthy homes measures and 13 received educational visits and low-cost measures (under \$1000), such as green cleaning kits, dust mite covers, and walk-off mats. A profile of measures installed is included as an attachment. See table A1.

Five of the 53 PCHS comprehensive households did not receive CHW visits because services were provided before the contract with the Health Department was in place or Wx+H measures were completed during the funding gap.

The final PCHH Partnership data set includes 48 households and 73 persons with respiratory conditions. Of 73 persons served, 29% were referred for COPD and 71% for asthma. All of the persons with COPD were adults, and of the 52 persons referred for asthma, 20 (38%) were adults. This represented a significant change from the Health Department’s previous work which focused on children with asthma.

Of the 48 households receiving services, more than seven in ten resided in manufactured homes and more than eight in ten owned their home. Clients referred to the program with COPD were more likely to receive comprehensive services – in part because they were less likely to be renters and thus more easily qualified

³ Wx+H is funded as part of Washington’s Capital Budget. The FY 2018 – 2019 Capital Budget was held up for nine months, due to an unrelated disagreement. This gap occurred in the window when most follow-up visits were scheduled to occur.

for weatherization services. COPD clients were also more likely to be retired senior citizens or disabled, and could more easily accommodate the time commitment required to allow program staff and contractors into the home.

Clients receiving Wx+H services relied on five different insurance systems and more than 15 separate insurers. One half received coverage through Medicaid, 31% through Medicare, 16% through private insurance, 5% through Tricare/Veterans system, and 5% through DSHS disability. One in five had multiple coverages – these are mostly adults with asthma and COPD. This complex payer mix makes it very challenging to comprehensively assess medical utilization outcomes or to develop medical system reimbursement for weatherization or home visit services.

Table 2. Household and Project Characteristics

	Households	Occupants referred for	
		Asthma	COPD
N=	48	52	21
Building Type			
Manufactured	71%	58%	86%
Site-built Single Family	23%	29%	14%
Multi-Family (2+ units)	6%	13%	0%
Tenure			
Owner - Occupied	83%	63%	100%
Rental	17%	37%	0%
Intervention			
Education Low - Cost	27%	33%	24%
Comprehensive	73%	67%	76%
Summary Medical Acuity (N)		(41)	(21)
High		21%	76%
Moderate		39%	5%
Low		39%	19%

Medical acuity refers to the likelihood a client’s health condition or situation will require medical interventions⁴. The complex relationship between the medical acuity of clients and the intensity of interventions (treatments) complicates efforts to establish a relationship between intensity of treatment and treatment effects. As Table 3 indicates, clients with high acuity were not more likely to receive comprehensive Wx+H services. A number of the higher acuity clients had other barriers to service such as mental health issues, homes in extremely poor repair, and uncooperative landlords. As a result of these barriers, they received low cost services as an alternative. This was consistent with the Health Department focus of engaging and referring *all* clients to additional services in order to build relationships, encourage clients to the next action step, refer to other services, and perhaps eventual completion.

⁴ The Health Department assessed the overall medical acuity of clients based on overall responses during intake and classified clients as low acuity (no minor co-morbid conditions and adequate or good control), moderate acuity (one serious co-morbid condition and/or poor control of respiratory condition) AND high acuity (multiple co-morbid condition – respiratory condition very poorly controlled).

Table 3. Types of Measures and Client Acuity

	High Acuity	Moderate Acuity	Low Acuity
Comprehensive	64%	94%	85%
Low Cost	36%	6%	15%

Initial CHW Recommendations

A comprehensive review of environmental triggers and medical management of respiratory conditions were core components of CHW services. CHWs worked with the families to develop agreed upon actions and strategies to improve health⁵. As shown in Table 4, more than ten initial action recommendations were identified for each client. Other key findings:

- More recommendations were made for COPD clients and adults with asthma, than children with asthma, in part because of higher acuity levels.
- Nine in ten clients (88%) had recommendations involving follow-up with a medical provider to schedule appointments, create an action plan or to adjust medications. One half had (48%) additional recommendations on how to better manage or use existing medications – such as proper use of spacers or masks – or how to use control medication more effectively. This highlights the unique role that CHWs can play in supplementing weatherization services by providing an environmental assessment, asthma and COPD education, motivational interviewing and follow-up services to encourage behavior change.

Table 4. Recommendations for Action by Referred Client

	All Persons	COPD	Asthma
N=	66	21	45
Total Recommendations	701	354	347
Average recommendations	10.6	16.9	7.7
Medical Provider	88%	95%	84%
Mold	76%	100%	64%
Ventilation	70%	95%	58%
Dust Mites and Cleaning	61%	90%	47%
Household Cleaning - Hzdous Material	59%	76%	51%
Medication Management	48%	71%	38%
Smoke - VAPE	42%	67%	31%
Pets	29%	52%	18%
Pest Control	20%	38%	11%
Landlord - Repairs	11%	0%	16%

⁵ This data reflects recommendations made at initial intake. Additional actions and recommendations may be identified during follow-up visits.

Follow-up Visits and Calls

Follow-up home visits or phone interviews were conducted with 35 households and included 47 persons with respiratory conditions. Of the 26 clients who did not receive a follow-up contact by home visit or phone:

- Ten had moved
- Four had died
- Two were hospitalized
- Four were not contacted because of safety issues or otherwise refused
- Six could not be contacted or scheduled for other reasons

Follow-up data collection was more likely to be completed for healthier persons (lower acuity), more stable households, and households that received comprehensive rather than lower cost services. One of the challenges of this work is that the highest needs households are often more medically fragile, less stable (more likely to move), and often harder to reach with behavioral interventions. Most homes that receive comprehensive measures are likely to remain in low income housing stock and the energy efficiency benefits will likely continue to accrue to low income households. The turnover in occupants with respiratory concerns that were specifically targeted for assistance suggests that the medical cost utilization benefits associated with structural or building targeted investments may be less certain and persistent than investments for individuals in behavior and practice – which are more portable. As these homes are also likely to remain in low-income housing stock, and low-income persons are likely to be medically vulnerable – improved air quality and temperature regulation is likely to confer benefits to future low-income occupants. This is challenging to measure directly.

Follow-up assessments were completed for three of five clients overall. The response rate for the home assessment was the lowest (42%). Return rates for client questionnaires varied by instrument with response rates somewhat lower for clients with COPD.

Table 5. Response Rates for Client Questionnaire

	Total	Asthma	COPD
Pre-Visits (Clients)	73	52	21
ACT/TRACK/CAT (control) (Asthma, Child Under 4)	45 (62%)	32 (62%)	13 (62%)
ACQ/ACQC (Medication - Medical)	43 (59%)	31 (60%)	12 (57%)
AQLQ/CCQ (Quality of Life)	37 (51%)	30 (58%)	7 (33%)
Home Assessment (Behavior Changes)	31 (42%)	24 (46%)	7 (33%)

Evidence of Action to Reduce Environmental Triggers

Twenty-one of 48 households had follow-up visits or calls that included systematic data collection on healthy homes actions and reduction of environmental triggers (Table 6)⁶. Eighteen (86%) of the 21 households reported that they made two or more changes to reduce environmental triggers (Table 6).

⁶ It is challenging to capture all measures and actions taken by clients as changes are made over time. All actions were not captured, and funding was not available for all follow-up visits. Home assessments were conducted by phone for six households and changes may be less reliably or completely captured.

Actions and behavior changes to reduce asthma triggers that were supported with low cost measures (HEPA vacuums, allergen covers, and green cleaning kits) were more likely to occur or be recalled. Results for some changes, such as cleaning curtains and blinds, were difficult to interpret or contradictory – which indicates there could be some client confusion. In some households, positive actions in one area were offset by actions or behaviors in other areas that may increase environmental triggers.

Table 6. Households with Pre and Post Home Assessments Reporting Action on Recommended Change to Reduce Environmental Triggers (Household n=21)

Recommended Change	Better	Worse	No Change	Not Applicable/ No Data
Vacuuming (HEPA)	67%	0%	10%	24%
Measure Humidity	48%	5%	24%	29%
Allergen Covers	48%	5%	10%	38%
Green Cleaning	38%	0%	24%	38%
Cleaning Blinds/Drapes	38%	14%	10%	38%
Reduce Scented Products	29%	5%	38%	24%
Reduce Smoke/Vaping Exposure	24%	10%	10%	57%
Air Purifier (no ozone/HEPA)	24%	5%	67%	5%
Pets/Dander Control	24%	19%	29%	29%

Health and Quality of Life Outcomes Measurement

The Health Department used multiple instruments to assess health and Quality of Life outcomes for asthma and COPD clients. Outcomes were measured in three areas:

- Overall symptom control was measured with the TRACK for Under Age 4, Asthma Control Test (ACT), or COPD Assessment Test (CAT)
- Impact on activities and medical system utilization was measured by the Asthma Control Questions (ACQ) and Asthma Control Questions for COPD (ACQC)
- Quality of Life was measured by the Juniper Asthma Quality of Life Questionnaire (AQLQ), Juniper Pediatric Asthma Caregiver Quality of Life Questionnaire (PACQLQ), and Clinical COPD Questionnaire (CCQ)

Specific score results are reported separately for asthma and COPD clients as the instruments and interpretation of findings differ. For example, asthma control is measured via the ACT which is scored on a scale of 0 to 25 – with higher scores indicating greater control. COPD control is measured by the CAT which is scored from 40 to 0 – with lower scores indicating greater control. Changes of three points in the ACT and five points in CAT are considered significant.

Although results from asthma and COPD instruments should not be directly compared – it is possible to classify whether completed questionnaires reported positive or negative changes, and whether those changes were significant, and as a result draw general conclusions about whether or not clients are experiencing positive and significant changes. See Attachment Table A2 for a summary of instruments and how they are scaled and scored.

Respiratory Control

Two-thirds (65%) of clients who administered an ACT/CAT – before and after CHW interventions – reported an improvement in respiratory control, with 47% reporting a significant improvement. One in five (19%) asthma clients reported a decrease in respiratory control at follow-up. Thirty percent of COPD clients reported a decline in control. Poorer outcomes may be partly associated with the timing of follow-up visits which were clustered in the spring during peak allergy season.

At the time of the first CHW home visit, 42% of asthma patients reported their asthma was controlled (ACT > 19) – this increased to 67% at follow-up. On average, ACT scores increased by a little under three points. This increase, which indicates improvement, was significant ($\alpha = .002 < .05$) for all asthma clients.

Table 7. Asthma and COPD Control Test Results

	All Persons	Persons with Asthma	Persons with COPD
N=	45	32	13
Significantly better	47%	50%	38%
Better	18%	16%	23%
No change (-1,0,+1)	13%	16%	8%
Worse	16%	16%	15%
Significantly worse	7%	3%	15%

CAT scores for COPD patients decreased (the direction of improvement) although the improvement was not significant ($\alpha = .151 > .05$). The percentage of COPD clients who reported their COPD was “controlled” or had low impact (CAT Score <10) increased from zero to 21%.

Table 8. Mean Change in Asthma Control Test and COPD Assessment Test

	Mean Pre – Mean Post	Mean Improvement (95% CI)	Pr (T > t) Mean diff > 0
Asthma*	18.3 → 21.2	2.9 (1.0 → 4.9)	.0021
COPD	25.1 → 22.8	2.3 (-2.4 → 7.0)	.1511

*Excludes two clients under age 4 who received the TRACK, one showed significant improvement and one showed minor improvement

A preliminary analysis of respiratory control outcomes by intensity of weatherization and home visit interventions, medical acuity of patients, or building need did not yield evidence of significant detectable differences. This was not surprising given the small sample sizes, high degree of variability in interventions and client conditions, and lack of a clear relationship between acuity (need) and intervention level.

Overall Quality of Life

Clients rated how much their respiratory condition impacted their symptoms, daily activities and mental health (specific items are listed in attached tables):

- Adults with asthma rated impacts in 15 areas on a scale of one (major impact) to seven (no impact)
- Parents of children with asthma rated impacts in 13 areas on a scale of one to seven
- Adults with COPD rated 12 areas on a scale zero (no impact) to six (major impact)

As with control measures for COPD clients, a low score indicates better Quality of Life (closer to one is better); for asthma clients, a higher score is better. Scores for all items are averaged for an overall assessment of Quality of Life. A change in average of score of one point is considered significant.

Seven in ten clients reported an improvement in average scores for Quality of Life indicators, with 38% reporting a significant improvement. Half (47%) of asthma clients and no COPD clients reported significant improvement.

Table 9. Asthma and COPD Quality of Life Results

Significant improvement (>1.0)	All Persons	Persons with Asthma	Persons with COPD
N=	37	30	7
Significantly better	38%	47%	0%
Better	32%	33%	29%
No Change (-.1,0,+1)	14%	13%	14%
Worse	11%	7%	29%
Significantly worse	5%	0%	29%

The mean Quality of Life score for adults with asthma and for the caregivers of children with asthma showed a statistically significant increase by over one point. All Quality of Life areas showed some improvement. The areas of greatest improvement (see Attachment Tables A3 and A4) were:

- Symptoms (coughing and chest tightness)
- Sleep (better sleep for clients and caregivers)
- Anxiety, frustration and worry
- Fewer impacts and interruptions for caregivers

Table 10. Change in Mean Quality of Life Index for Asthma and COPD Clients

	Mean Pre – Mean Post	Mean Improvement (95% CI)	Pr (T > t) Mean diff > 0
Asthma Adult*	4.20 → 5.51	1.31 (.64 → 1.99)	.0006
Asthma Child (caregiver)	5.57 → 6.85	1.12 (.46 → 1.76)	.0011
COPD	3.71 → 3.45	-.1 (-1.5 → .96)	.5878

Table 11 suggests that much of the movement was from “Moderate to Minor impact” to “No impact”.

Table 11. Asthma Impact on Quality of Life Before and After Intervention

Impact on Quality of Life	Before Intervention	After Intervention
Asthma (n=)	(30)	(30)
Severe (3.9 or lower)	23%	3%
Moderate (4 – 5.9)	40%	27%
Minor (6-6.9)	33%	20%
None (7.0)	3%	50%

Overall Mean Quality of Life score for COPD clients showed slight, statistically insignificant decrease (Table 11). Results for specific measures were mixed with some areas showing improvement:

- Shortness of breath at rest
- Anxiety about breathing
- Impacts on social activities
- Chest mucus

And others reported as being worse (see Attachment Table A5):

- Coughing
- Shortness of breath while doing physical activity

CHWs noted that poorer reported quality outcomes were related to greater medical acuity and fragility for adults, especially those with COPD. They also noted that in some cases education increased participant awareness of how their health conditions were impacting their lives.

Impacts on Activities and Self-reported Medical Utilization

Forty-two clients reported how their respiratory condition affected school, work and medical visits via the ACQ and ACQC.

- **Work or School:** During the past four weeks, how many days of work/school/normal activities did you miss due to your asthma or COPD?
- **Caregiver Impacts:** During the past 4 weeks, how many days of work/school/normal activities did anyone who cares for you miss due to your asthma or COPD?
- **Urgent Care:** In the last year, how many times have you visited Urgent Care or had a same day visit with a provider due to asthma or COPD?
- **Emergency Room Visits:** In the last year, how many times have you visited the Emergency Room due to asthma or COPD?
- **Hospital Admissions:** How many of these resulted in a hospital admission?

We calculated the total net change (pre – post). At the time of the pre-questionnaire, clients reported visits in the prior year. For the follow-up, clients were asked to recall the number of visits since the previous home visit, typically 9 to 12 months.

As shown in Table 13, there was a net decrease in missed work or school and medical visits across all clients. Asthma clients reported net reductions with greater reductions in Urgent Care and Emergency Room visits. COPD clients reported net increases – especially in caregiver impacts and Urgent Care visits – both of which are likely linked to COPD clients' greater initial medical acuity.

Table 12. Total Net Change (Fewer is Better) in Missed Days and Medical Visits (n=42)

	Work or school (4 weeks)	Caregiver (4 weeks)	Urgent Care (Year)	Emergency Room (Year)	Hospital Admission (Year)
Total Net Change	-4	-2	-4	-15	-6
Total Asthma	-7	-8	-12	-15	-8
Under 4	-3	-2	-4	-4	0
4-11	-1	-1	2	-2	0
12-17	-3	-4	-5	-3	-4
Adults	0	-1	-5	-6	-4
Total COPD	3	6	8	0	2

Table 13 reports net changes per client per month or per year which would be of use in projecting potential program impacts to future programs.

Table 13. Net Change per Client

	Work or school (4 weeks)	Caregiver (4 weeks)	Urgent Care (Year)	Emergency Room (Year)	Hospital Admission (Year)
Total	-0.10	-0.05	-0.10	-0.36	-0.14
Total Asthma	-0.23	-0.27	-0.40	-0.50	-0.27
COPD	0.25	0.50	0.67	0.00	0.17

Summary

Initial results from the PCHH Initiative are promising. They suggest that despite a complex client mix and small sample size, it was possible to detect evidence of improved health outcomes, improved Quality of Life and lower use of medical services. This case study also highlights the challenges and opportunities of providing integrated weatherization, healthy homes and home visit services to low income weatherization clients.

- Low income weatherization clients are diverse with multiple health conditions, living situations and health care payers.
- Adults with asthma and COPD have high medical acuity and are likely to be medically fragile. A third of those receiving services moved out, dropped out, died or had other serious health reversals. While remaining and future occupants are likely to experience benefits – this complicates efforts to directly measure and attribute health outcomes and decreased medical system utilization to program services.
- CHWs must have the skills to address multiple health conditions including asthma, COPD, mental health and co-morbid conditions. Weatherization program staff also needs additional training and support to work with these clients.
- It is challenging to align weatherization program requirements, client need and client readiness.

- It is essential to coordinate weatherization and CHW services and maintain coordination of services over a long period to see benefits. As the stories which close this case study indicate, progress in individual cases can be incremental, may take multiple visits and involve setbacks.

We close with four stories provided by Health Department CHWs that illustrate how clients describe the program and the difference it made in their lives. And, why – despite the challenges described above – weatherization staff at PCHS and CHWs at the Health Department remain passionate about the work. Pseudonyms are used to protect client confidentiality. Additional stories are attached.

Stories from the Field

Lorraine

Lorraine is a single retired veteran, who has several health issues. She has dealt with asthma for many years. During her follow-up interview, she shared how happy and grateful she was for the Wx+H program. Her asthma is improved and she has been able to be out in her yard gardening more. “The only time I take a break is when I overdo it due to arthritis.” Since Lorraine started the program she uses a spacer (a plastic or metal tube that makes it easier to use an inhaler) with her medication, has not had any urgent or same day Primary Care appointments – due to asthma – and her ACT score went from 10 to 25, indicating well-controlled asthma. She is better able to vacuum with the light weight HEPA vacuum provided by the program. She is enjoying that she has proper insulation that keeps her home warmer in the colder weather and working fans that are extremely helpful, as well. She shared with the Asthma CHW that she was “...grateful for the contractors that serviced my furnace and repaired it. I could not have afforded that.”

The DiAngelos

Mr. and Mrs. DiAngelo had no idea programs like Wx+H existed until they learned about it at the food bank where they volunteered. They were worried about their finances, but did not want to let others know what was going on. They had a very high electric bill and Mrs. DiAngelo had to refill her asthma inhalers. They had to choose whether to pay their electric bill or refill the medication.

One of the ladies that volunteered with them noticed that they were not acting normal and asked if everything was okay. Mr. DiAngelo let her know that he was worried about his wife not getting her medication. His fellow volunteer patted him on his back and said, “Don’t worry. I have a number you can call and they will help pay for your electric bill.” He called Energy Assistance that day and a “...really nice lady answered the phone and talked to me about Energy Assistance and the Weatherization Plus Health program.” She told him what information to bring into the office, in order to apply and qualify for the Energy Assistance program and also for Wx+H program. After his appointment, he told Mrs. DiAngelo that someone from the Health Department was going to come and teach her about her asthma, and that weatherization staff would also come and walk through the house to see what repairs their home needed.

Mr. DiAngelo said, “When the time came for our asthma appointment, we felt so relieved. The Community Health Worker showed both of us that my wife, for so many years, was not using her

inhalers the proper way. We also found out that the cleaning supplies we were using were causing my wife's asthma to not get better at all. Or in other words, I would say we both were breathing this very strong chemical that smelled good but was not safe for us to use." The CHW provided the family with a green cleaning kit and a HEPA vacuum.

Weatherization staff determined that the home needed insulation under the floors, bathroom exhaust fans, and a ductless heat pump in the living room and air filter.

"We have noticed a big change inside our home since the work was done. We have been doing what the (Community Health) Worker recommended and we've noticed our electrical bill is not high anymore." Mrs. DiAngelo's asthma has improved since her last home visit and she can do more things around the home and go out for longer walks. "Thank you to everyone that made this possible, we feel so blessed," she said.

Linda

Linda expressed gratitude for these types of programs, especially for "Seniors like myself, that are just living out of an SSI paycheck...that sometimes have to pick if they eat or pay to have a roof over them." After the weatherization work, her winter bills dropped from \$300 dollars a month to \$98 - \$150 dollars." Linda is very grateful with the asthma education she received that "explains everything" and she is following the recommendations of her CHW. Her ACT score has improved. On her second home visit the CHW noticed Linda had stopped using the plug-in air fresheners since her first home visit. Linda feels her asthma has improved and she is able to do more around her home and can garden more without running out of breath like before. She no longer needs to use her inhaler more than 2-3 times per week. She had great compliments about staff from the weatherization program. "All the work they did in my home was such a blessing to me. I could never have done it on my own," she said.

Rose

Rose entered the Wx+H program as a single mother, to find help for her two children who both suffered from asthma since they were young. She did not understand the correct use of their prescribed asthma medication and, as a result, was giving the children Albuterol when she should have given them Qvar, and giving them Qvar when she should have given them Albuterol.

The home had moderate clutter throughout, and mold in her bathroom – due to a water leak under her trailer. After receiving recommendations and supplies from the CHW, she now understands her children's medication. She is using her green cleaning supplies – especially to stay on top of the mold – and has reduced the clutter. She could not believe everything she was able to do with vinegar. She talked about opening her windows more often for ventilation and how much the vacuum has helped. Her plumbing was fixed by program contractors – something she said she could not afford to fix.

The children's asthma is much better, Rose said, "I only see a difference with weather and season changes, but it's not as bad as before." She appreciates the supplies and the information and is thankful for the program and what it has done for her family.

Attachments

Measure Profile for PCHH Wx+H Projects Compared to All Other Wx+H Pilot Grantees

Table A1. Percentage of Wx+H Projects with Healthy Homes and Weatherization Measure Installed (n=43)

	Plus Health Measures			Weatherization Measures	
	All Grantees	PCHS		All Grantees	PCHS
Green cleaning kit	94%	88%	Air sealing	77%	77%
Bedding (dust mite)	71%	62%	Floor insulation	44%	56%
Mechanical ventilation	65%	65%	Attic insulation	54%	60%
HEPA vacuum	65%	79%	Wall insulation	12%	2%
Walk-off mats	65%	87%	Windows	17%	7%
CO detector	57%	54%	Door	19%	16%
Low VOC flooring	33%	6%	Duct insulation	20%	23%
Smoke detector	24%	4%	Duct repair	10%	26%
Advanced ventilation	18%	8%	Duct sealing	33%	44%
HEPA/MEPA filter	17%	17%	HVAC - replace	33%	60%
HVAC cleaning	17%	4%	Furnace T and Cn	22%	47%
Air filter	15%	33%	HVAC - repair	13%	16%
Plumbing repair	13%	21%	Thermostat	15%	26%
Gutter, downspout	13%	10%	Passive venting	44%	47%
Moisture/mold abatement	13%	6%	Lighting	33%	47%
Roof repair/replace	11%	21%	WH low cost	52%	65%
Pest mitigation	9%		Water heater	12%	12%
Comprehensive cleaning	8%		Electrical repair	13%	19%
Crawlspace	7%		Wx repair	1%	
Slip/fall prevention	5%	10%			
Dehumidifier	2%	2%			

Darker cell colors indicate higher rates of installation.

Blank cells indicate that a measure was not installed by the grantee.

Summary of Client Questionnaires Used In Case Study

The following instruments were administered by CHWs during follow-up visits.

Table A2. Client Questionnaire Summary

	Instrument Name	Score Range	Interpretation Notes
Asthma		Worse → Better	
Respiratory Control	Asthma Control Test (ACT) Track (under age 4)	0 25 0 100	20 or greater in control ➤ +/- 3 significant change 80 or greater in control ➤ +/- 10 significant change
Activities Lost School Medical care	Asthma Control Question (ACQ) Separate instruments by age group	4+ → 0	4 or more counted as 4. Net Post – Pre events summed - decline (negative change or reductions desirable)
Quality of Life	PACQLQ (Children) 13 Items AQLQ (Adults) 15 items	1 → 7	Average score 1-4 Severe Impact, 4-5.9 Moderate, 6-6.9 minor, 7 no impact. ➤ An increase or decrease in average score across all items greater or equal to one is a significant change
COPD			
Control	COPD Assessment Test (CAT)	40 → 0	Lower is better <10 Low Impact, 10-20 Moderate Impact, 21-30 High Impact, Over 30 Very High Impact ➤ +/- 5 significant change
Activities Lost School Medical care	Asthma Control Questions for COPD (ACQC)	4+ → 1	4 or more counted as 4. Net Post – Pre events summed - decline (negative change or reduction desirable)
Quality of Life	Clinical COPD Questionnaire (CCQ) – 12 items	6 → 0	Lower is better, 5.5 or higher very poor, 4-5.4 poor, 2-4 moderate, under 2 good. ➤ An increase or decrease in average score across all items greater or equal to one is a significant change

Quality of Life

Table A3. Quality of Life Outcomes for Adults with Asthma – Summary of Mean Change in Score

Asthma Quality of Life Questionnaire (AQLQ) Score (1 = all the time – 7 none of the time)	Mean	
Adult Quality of Life Questionnaire items – During the past week, how concerned were you about these things?	Pre Score	Improvement
Feel bothered by coughing?	3.2	1.0
Have difficulty getting a good night's sleep as a result of your asthma?	3.8	1.0
Feel bothered by or have to avoid cigarette smoke in the environment?	2.9	0.9
Experience a feeling of chest tightness or chest heaviness?	4.1	0.8
Feel concerned about having asthma?	4.2	0.7
Feel frustrated as a result of your asthma?	4.4	0.7
Feel bothered by or have to avoid dust in the environment?	3.2	0.6
Social activities (such as talking, playing with pets/children, visiting friends/relatives)	4.8	0.6
Feel short of breath as a result of your asthma?	3.8	0.5
Experience a wheeze in your chest?	3.8	0.5
Strenuous activities (such as hurrying, exercising, running upstairs, sports)	4.0	0.4
Work-related activities (tasks you have to do at work, school or any tasks you have to do most days)	5.3	0.4
Feel afraid of not having your asthma medication available?	5.3	0.2
Moderate activities (such as walking, housework, gardening, shopping, climbing stairs)	4.5	0.2
Feel bothered by or have to avoid going outside because of weather or air pollution?	4.5	0.2

Table A4. Quality of Life Outcomes for Caregivers of Children with Asthma – Summary of Mean Score Changes

Parents of Asthmatic Children Quality of Life Questionnaire (PACQLQ) Score (1 = all the time – 7 none of the time)	Mean	
Parent Asthma Quality of Life Questionnaire items – During the past week how concerned were you about these things?	Pre Score	Improvement
Your child's performance of normal daily activities?	5.0	1.8
Did your family need to change plans because of your child's asthma?	5.3	1.7
Did your child's asthma interfere with your job or work around the house?	5.3	1.6
Did you feel helpless or frightened when your child experienced cough, wheeze or breathlessness?	5.3	1.6
Were you awakened during the night because of your child's asthma?	5.4	1.2
About being over-protective of your child?	5.8	1.1
Did you feel frustrated or impatient because your child was irritable due to asthma?	5.8	1.0
Did you have sleepless nights because of your child's asthma?	5.5	1.0
About your child being able to lead a normal life?	5.8	1.0
Did you feel upset because of your child's cough, wheeze or breathlessness?	5.9	0.9
Did you feel angry that your child has asthma?	6.2	0.8
About your child's asthma medications and side effects?	6.3	0.6
Were you bothered because your child's asthma interfered with family relationships?	6.3	0.6

Table A5. Quality of Life Outcomes for Adults with COPD – Summary of Mean Score Changes

Clinical COPD Questionnaire (CCQ) – During the past week, how concerned were you about these things? (Zero none of the time 6 all of the time)	Pre Score	Change
Short of breath while at rest?	3.6	2.0
How often do you feel anxious because of your breathing problems?	2.6	1.1
Social activities (such as talking, being with children, visiting friends/relatives)?	3.5	0.9
Did you produce sputum or phlegm (chest mucus)?	3.9	0.8
How often do you feel depressed because breathing problems keep you from doing what you enjoy?	2.4	0.7
Daily activities at home (such as dressing, washing yourself)?	2.9	0.3
Moderate physical activities (such as walking, housework, carrying things)?	3.9	0.1
Strenuous physical activities (such as climbing stairs, hurrying, participating in sports)?	3.9	0.0
Concerned about getting a cold or your breathing getting worse?	4.0	-0.3
Depressed (down) because of your breathing problems?	3.5	-0.3
Did you cough?	4.0	-0.4
Short of breath while doing physical activities?	4.0	-0.5