Exploring Potential Health Benefits of Home Weatherization in Vermont

This document gives a detailed summary of the analytic methods we used to explore the potential for home weatherization to improve health for Vermonters on Medicaid. This summary is intended for technical users. See the <u>visual</u> or <u>two-page</u> summaries for a more general overview of our methods and findings.

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Background

Home weatherization is widely recognized as an effective means to increase energy efficiency in buildings. Weatherization can also produce substantial non-energy benefits such as improved indoor thermal comfort, indoor air quality and other environmental health benefits.

Weatherization + Health approaches integrate additional services specifically designed to provide potential health benefits to further enhance occupant health and safety beyond traditional weatherization. For example, in addition to addressing issues related to insulation, air sealing and combustion safety, a Weatherization + Health approach may also address issues like mold and pest remediation, removing carpets and providing healthy homes education to residents.

Both traditional home weatherization and Weatherization + Health strategies have been shown to have beneficial effects on general health and specific health outcomes like respiratory disease, cardiovascular disease, arthritis and chronic headaches^{1-11, 14, 15}. For additional information about the potential health benefits of home weatherization, please see the Health Department's <u>Weatherization + Health technical report</u>.

The following analysis was designed to explore and identify whether Vermont Medicaid recipients experienced improved health outcomes as a result of receiving home weatherization services.

Methods

A survey administered by the Department for Children and Families indicated that about 50% of Vermont State Weatherization Assistance Program (WAP) recipients are also Medicaid recipients. The Vermont Agency of Human Services Institutional Review Board approved a data linkage project, in which the Department of Vermont Health Access (DVHA) matched a list of WAP recipients (provided by the Office of Economic Opportunity at the Vermont Department for Children and Families) who received services between 2009 and 2019 to individuals in the Medicaid claims database.

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DVHA developed the analytical sample as follows: Weatherization recipients were eligible for inclusion if they had at least 12 months of Medicaid enrollment during each of the 24-month periods before and after their weatherization project was completed. Matched controls for each weatherization recipient were selected from the Medicaid claims database by identifying individuals enrolled at a similar point in time as each weatherization recipient and who had at least 12 months of Medicaid enrollment during each of the 24-month periods before and after July 1 of the year in which their matched weatherization recipient's project was completed. July 1 was chosen as the "anchor date" because that is the effective date for Medicaid enrollment changes in Vermont. Controls were further matched to weatherization recipients based on their age band, sex, Medicaid eligibility group, and whether they were enrolled in Medicare due to being under age 65 with a disability.

Following the process above, DVHA sent the Vermont Department of Health a de-identified dataset for further analysis, containing WAP and Medicaid data for 1,800 WAP recipients and Medicaid data for about 14,000 frequency matched controls.

Health Department staff further limited the analytic sample to adults (ages 18-64) and children (ages 2-17) who were solely Medicaid recipients (i.e., they didn't have another type of co-insurance). This reduced the final analytic sample size to 1,473 weatherization recipients and 11,929 controls.

Respiratory health visits were defined as the combined claims on the same day (or consecutive days for inpatient care) for the same patient for emergency department (ED) care, inpatient hospital care, or primary care for asthma, chronic obstructive pulmonary disease (COPD), or other upper respiratory causes (ICD-9 codes: 460-466, 470-478, 490-492, 493, 496; ICD-10 codes: J00-J06, J40-J45). For children, respiratory health visits only include ED and primary care because the numbers for inpatient hospitalizations were too small to conduct a reliable statistical analysis.

Cardiovascular health visits were defined as the combined claims on the same day (or consecutive days for inpatient care) for the same patient for emergency department (ED) care, inpatient hospital care, or primary care for cardiovascular disease, hypertension, or other cardiovascular causes (ICD-9 codes: 401-405, 410-414, 420-429; ICD-10 codes: I10-I16, I20-I25, I30-I52).

In most cases, one Medicaid claim corresponded to a visit. In instances where this was not the case, the costs of all claims associated with the visit were added together to calculate the cost of that visit.



Metrics calculated	for each of these categories of health care	for each of these types of health care visits.
Rate of visits	Adult respiratory care	emergency department visitsinpatient hospital visitsprimary care visits
Average cost of visits	Adult cardiovascular care	emergency department visitsinpatient hospital visitsprimary care visits
	Child respiratory care	emergency department visitsprimary care visits

Rates of visits (per 10,000 average annual enrollments) and average costs of visits were calculated separately for weatherization recipients and matched controls, for the preweatherization (or anchor date) period and the post-weatherization (or anchor date) period and for each type of health visit. All comparisons made are summarized in the visual below:

Each metric was calculated for each of the following groups, and compared across the dimensions indicated by the arrows:



Of note, our pre and post populations are dynamic, meaning that people with a certain type of claim in the pre period are not necessarily the same people who had similar types of claims in the post period. This is a visit-level analysis, not a person-level analysis.

Differences in rates of visit between analytical groups were evaluated for statistical significance using z-tests. Differences in average costs of visits between analytical groups were evaluated for statistical significance using t-tests. Findings were considered statistically significant if the p-value was <0.05.

The cost savings to Medicaid over two years was calculated by first multiplying the rate of a specific type of care (for example, respiratory ED visits) by the average cost of a visit for that type of care. This was repeated for every type of care for each analytical group during the pre and post periods. Then, the post values were subtracted from the pre values for each group



to estimate the cost difference that may be attributable to the impact of weatherization. This value was then divided by 10,000 to estimate the cost savings per average annual enrollment.

Analytic Questions

- 1. Does occupant health improve after receiving home weatherization services?
- 2. Do health care use and costs decrease for occupants after receiving home weatherization services? Do costs to Medicaid decrease?

Results

Results of our analysis are below. They are broken down by age group (adult or children) and health outcome. All results should be interpreted in the context of the limitations section that follows.

Adults – Respiratory Health

Rate of Respiratory Health Visits - Weatherization Group

Weatherization recipients had significantly higher rates of inpatient visits in the post period. Rates of ED and primary care visits stayed about the same in the pre and post periods.



*Statistical difference. Source: Vermont Medicaid Claims Data, 2009-2019

Rate of Respiratory Health Visits - Control Group

The Control group had no difference in rate of ED or primary care visits in the pre and post periods. The rate of inpatient visits increased in the post period.



Rate of Visits Pre Rate of Visits Post



*Statistical difference. Source: Vermont Medicaid Claims Data, 2009-2019

In general, there were no differences in average cost of a visit between the two groups. In the post period, the Weatherization group, on average, had lower costs of primary care visits.

Type of Care	Average Cost of Visit Pre	Average Cost of Visit Post	Summary
Emergency	W: \$94	W: \$122	No statistically
Department Visits	C: \$98	C: \$87	significant differences.
Inpatient	W: \$1,241	W: \$807	No statistically
Hospitalizations	C:\$971	C: \$986	significant differences.
	W: \$89	W: \$90	The W group had
Primary Care	C: \$91	C: \$99	than the C group in the post period.

W: Weatherization group. C: Control group.

*Costs adjusted for inflation to 2023 dollars.

Adults – Cardiovascular Health

Rate of Cardiovascular Health Visits – Weatherization Group

There were no significant differences in rates of ED, inpatient or primary care visits for the Weatherization group.





Source: Vermont Medicaid Claims Data, 2009-2019

Rate of Cardiovascular Health Visits – Control Group

The Control group experienced statistically significant increases in rates of ED, inpatient, and primary care visits when comparing the pre and post periods.



*Statistical difference. Source: Vermont Medicaid Claims Data, 2009-2019

While rates of cardiovascular visits significantly increased for all three types of care for the Control group, the Weatherization group rates stayed the same or decreased.

The Weatherization group had higher average costs per visit than the Control group for primary care in both the pre and post periods (post period: \$110 per visit vs. \$97 per visit). In the post period, costs were statistically similar between the groups for both ED and inpatient visits.



Type of Care	Average Cost of Visit Pre	Average Cost of Visit Post	Summary
Emergency	W: \$95	W: \$62	No statistically
Department Visits	C: \$70	C: \$64	significant differences.
Innatient	W: \$2,249	W: \$1,078	W significantly higher than C in the pre period
Hospitalizations	C: \$1,142	C: \$954	No difference in the post period.
Primary Care	W: \$101	W: \$110	W higher than C in both
	C: \$94	C: \$97	pre and post periods.

W: Weatherization group. C: Control group.

*Costs adjusted for inflation to 2023 dollars.

Children – Respiratory Health

Rate of Respiratory Health Visits - Weatherization Group, Children

Both the Weatherization and Control groups had lower rates of ED and primary care visits in the post period. The decreases were statistically significant for all comparisons except Weatherization ED visit rates.



*Statistical difference. Source: Vermont Medicaid Claims Data, 2009-2019





Rate of Respiratory Health Visits - Control Group, Children



The Weatherization and Control groups had significantly similar rates of respiratory ED visits in both the pre and post periods. The average cost of an ED visit was statistically similar between the two groups. The average cost of a primary care visit increased for both groups in the post period. The Weatherization group had statistically higher average costs of primary care visits than the Control group in both the pre and post periods (post period: \$145 per visit vs. \$133 per visit).

Type of Care	Average Cost of Visit Pre	Average Cost of Visit Post	Summary
Emergency Department Visits	W: \$149 C: \$120	W: \$129 C: \$127	No statistically significant differences.
Primary Care	W: \$133 C: \$127	W: \$145 C: \$133	Costs increased for both groups in the post period. W higher than C in both pre and post period.

W: Weatherization group. C: Control group.

*Costs adjusted for inflation to 2023 dollars.

Putting it Together: Medicaid Costs Savings over Two Years

Using the data described above, we can calculate how much money Medicaid saved (in total, per individual, and per household) during the 2 years after enrollees received home



weatherization services, as compared to Medicaid enrollees who did not receive weatherization services.

Type of Care	Cost Difference for Weatherization Recipients*
Respiratory (Adults)	\$19,477 more expensive
Cardiovascular (Adults)	\$1,783,220 less expensive
Respiratory (Kids)	\$314,060 less expensive

*Costs adjusted for inflation to 2023 dollars.

Cost Savings per 12 months of Medicaid Enrollment*
\$176
\$31

*Costs adjusted for inflation to 2023 dollars.

Household Description	Cost Savings Over Two Years*
1 adult and 1 child	\$416
2 adults	\$706
2 adults and 1 child	\$768
2 adults and 2 children	\$831

*Specific to respiratory and cardiovascular health care costs. Costs adjusted for inflation to 2023 dollars.

Key Findings

- 1. In this analysis, inpatient respiratory visits increased more for adults in the weatherization group than for adults in the control group.
- 2. Visits for cardiovascular conditions stayed the same for the weatherization group while they increased for the control group.
- 3. Among children, the weatherization group experienced larger decreases in respiratory visits than the control group.
- 4. Medicaid costs were lower for the weatherization group for respiratory care (children) and cardiovascular care (adults) for the 2 years after receiving weatherization services.



Limitations and Caveats for Interpretation

There are several limitations to this analysis that are important to consider. First, insurance claims data are collected for administrative purposes, not for public health surveillance work.

Second, our weatherization sample was a convenience sample of people that applied for, and actually received weatherization services, rather than a group of individuals randomly selected from the overall Vermont population. Convenience sampling increases the risk of sampling bias, meaning that weatherization recipients might be systematically different from the overall population.

For example, the Weatherization group had higher rates of health care utilization at baseline. This could be for a few different reasons, such as the Weatherization group having worse health at baseline, or being more likely to be users of "systems" in general. In addition, we theorize that our sample of weatherization recipients are more likely to be homeowners than the Medicaid population as a whole and therefore may be at the higher end of the Medicaid income distribution. This is because while the WAP is available to renters as well as homeowners, challenges in working with landlords and/or weatherizing multifamily housing means that in practice the majority of WAP recipients are homeowners.

WAP recipients were not selected because they were high health care utilizers at baseline, nor did they receive any "+ health" services specifically designed to address health concerns. This may have reduced the likelihood of detecting health benefits in our analysis. Other research has suggested that narrowly targeting Weatherization + Health services specifically to individuals with preexisting health conditions may deliver the largest benefits¹².

The Weatherization group was smaller than the Control group, so rates and average costs of claims in the Weatherization group might be more easily skewed by outliers or "superusers" of the health care system.

We don't know how long people stayed in the weatherized home before or after their weatherization project was complete, so it is possible they could have lived somewhere else during part of the 24-month pre or post period.

Lastly, while we did control for quite a few common confounders like age and sex during our matching process, there are other potential confounders that we did not have data to control for, such as owning versus renting one's home, employment status or preexisting health conditions.

Our mixed findings are consistent with other studies looking at weatherization interventions alone. There is potential for greater health impacts with approaches that blend both traditional weatherization interventions with healthy homes programs¹². Studies have not consistently found that weatherization positively impacts some respiratory conditions, such

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as asthma. Studies looking specifically at Weatherization + Health interventions have found more consistent improvement in asthma and upper respiratory symptom severity. These improvements were more common when the intervention specifically targeted those with chronic respiratory issues. A few studies have shown improvements in measures of cardiovascular health, including blood pressure and angina. Some studies have indicated a decrease in health care utilization and costs following weatherization, while others have found inconclusive results. A brief summary of the literature can be found in the table below.

Interpretation of this Analysis	Comparison to Published Evidence
Weatherization does not appear to have a beneficial impact on rate of adult respiratory visits. Among children, weatherization may have contributed to a larger decrease in respiratory visits.	Studies have not consistently found that weatherization positively impacts some respiratory conditions, such as asthma. Studies looking specifically at Weatherization + Health interventions found consistent improvement in asthma symptom severity. Studies looking at upper respiratory symptoms found a positive association between weatherization and reduction of symptoms for hay fever, allergies and sinusitis. These improvements were more common when the intervention specifically targeted those with chronic respiratory issues.
Weatherization may have had a beneficial impact on rates of visits for cardiovascular conditions.	A few studies have shown improvements in measures of cardiovascular health, including blood pressure and angina.
Weatherization may have resulted in modest cost savings to Medicaid at the household level over two years.	Some studies have indicated a decrease in health care utilization and costs following weatherization, while others have found inconclusive results.

Interpretation in Context

Conclusions

This analysis focused on the health impacts of basic home weatherization for Vermont Medicaid recipients and found the potential for modest benefits among some types of health care (adult cardiovascular health and children's respiratory health). Given our small population in Vermont and the imperfect sample used for this analysis, it is not surprising



that our findings are mixed. These results should be considered as part of a larger body of national evidence exploring the health benefits of home weatherization. More national research is needed, both to fully understand the potential health benefits of home weatherization and to understand why health outcomes like asthma do not consistently show a benefit of weatherization across different studies¹³.

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