

# HEALTH AND HOUSEHOLD BENEFITS ATTRIBUTABLE TO THE KNOXVILLE EXTREME ENERGY MAKEOVER (KEEM) PROJECT: PRELIMINARY RESULTS

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# OUTLINE

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# How Weatherization (WX) Can Yield Health Benefits

**Weatherization Programs  
Install Measures That:**



**Physically Change  
Homes in Ways That:**



**Save Households  
Money, and Then:**



**Directly Improve  
Health, and Then:**



**Indirectly Improve  
Health**



**Indirectly Save  
Households Money**



**Commonly installed weatherization measures include:**

- 1- air sealing;
- 2- insulation;
- 3- furnace, refrigerator, and water heater repair/replacement;
- 4- water heater adjustments; and,
- 5- furnace and dryer vent cleaning.

**Common ways households save money include:**

- 1- energy costs;
- 2- water costs; and,
- 3- reduced costs for utility disconnections and reconnections.

**Common ways saving money improves health include:**

- 1- increased ability to afford food and prescriptions; and,
- 2- reduced need for pregnant women to face heat or eat decisions.

**Common physical changes include:**

- 1- reduced allergens and pests;
- 2- improved thermal performance;
- 3- reduced mold and mildew; and
- 4- increased noise insulation.

**Common health improvements include:**

- 1- reduced asthma symptoms;
- 2- reduced thermal stress;
- 3- fewer colds and flu;
- 4- reduced poor mental health days; and,
- 5- reduced # days of poor rest/sleep.

**Common ways that health improvements indirectly save money include:**

- 1- reduced missed days of work from being sick or having a household member being sick (results in less lost income); and,
- 2- reduced out-of-pocket expenses incurred from illnesses.

**Other thoughts:**

- 1- households in better financial condition may be able to forego predatory loans, which further decreases financial strains; and,
- 2- improvements in health and finances may lead to improved mental health, which in turn may lead to further health improvements.

# Research Design

- KEEM installed weatherization (Wx) measures in low-income, electrically-heated, single family homes in the City of Knoxville (e.g., air sealing, insulation).
- The goal was to reduce energy consumption by 25%.
- This spring and summer (2017), a phone survey was administered to three groups of homes:
  - CwT -- Comparison with Treatment Group (i.e., already received weatherization)
  - T -- Treatment Group (i.e., will receive weatherization during course of study)
  - CWL -- Control Waiting List Group (i.e., will not be weatherized during course of study)
- The survey collected data on reported health conditions, home conditions, budget issues and demographics.
- The survey will be repeated next summer (2018).

# Demographic Characteristics

| Variable/Group                       | CwT<br>(N=150) | T Pre-Wx<br>(N=88) | CWL<br>(N=197) |
|--------------------------------------|----------------|--------------------|----------------|
| Respondent Gender: Female            | 73.1%          | 78.4%              | 78.7%          |
| Respondent Age                       | 58             | 55                 | 56             |
| Average Household Size               | 2.03           | 2.03               | 2.17           |
| Black or African American            | 44.7%          | 33.0%              | 26.7%          |
| Respondent Employed                  | 35.0%          | 39.8%              | 37.4%          |
| Respondent Retired                   | 30.5%          | 22.7%              | 25.3%          |
| Respondent Married                   | 19.8%          | 22.7%              | 26.7%          |
| Respondent Education: GED<br>or less | 50.2%          | 43.1%              | 58.0%          |

# Dwelling Quality Results

| Survey Item/Group  | CwT   | T Pre-Wx | CWL   |
|--|-------|----------|-------|
| Home sometimes at unhealthy temperature                  | 12.7% | 51.2%    | 42.6% |
| Home was observed to be drafty                           | 12.2% | 45.4%    | 34.7% |
| Frequent mildew odor or musty smell                      | 27.4% | 40.9%    | 40.7% |
| Have seen mold in home                                   | 29.9% | 42.0%    | 37.3% |
| Home is somewhat, very, or extremely infested by insects | 21.8% | 26.1%    | 39.3% |
| Home is somewhat, very or extremely infested by mice     | 22.8% | 31.8%    | 25.3% |
| Home is dusty most to all of the time                    | 30.4% | 57.9%    | 51.3% |

# Household Equipment Results

| Survey Item/Group                                    | CwT   | T Pre-Wx | CWL   |
|--|-------|----------|-------|
| Broken Heating Equipment (last 12 months)            | 9.1%  | 38.6%    | 20.7% |
| Broken Cooling Equipment (last 12 months)            | 8.1%  | 30.7%    | 38.7% |
| Used Oven to heat house sometimes to all of the time | 3.5%  | 16.0%    | 16.7% |
| Bathroom With Working Vent Fan                       | 62.4% | 53.4%    | 60.0% |
| Home Has CO Monitor                                  | 26.4% | 23.9%    | 18.7% |
| Home Has Smoke Detector                              | 95.4% | 92.0%    | 92.7% |



# Health Results

| Survey Item/Group   | CwT   | T Pre-Wx | CWL   |
|---|-------|----------|-------|
| Asthma Prevalence (main respondent)                               | 18.8% | 14.8%    | 15.3% |
| Asthma Symptoms (<3 months since last)*                           | 78.3% | 77.0%    | 56.4% |
| Asthma Emergency Department Visits*                               | 8.1%  | 7.7%     | 30.4% |
| Asthma Hospitalizations*  | 0     | 0        | 4.3%  |
| Medical attention too hot   | 0.5%  | 0        | 0.7%  |
| Medical attention too cold  | 0.5%  | 4.5%     | 5.3%  |
| Number of days poor health kept from normal activities past month | 7.1   | 11.4     | 9.6   |
| Number of days previous month physical health not good            | 7.2   | 12.8     | 9.8   |
| Number of days previous month mental health not good              | 4.8   | 9.7      | 8.0   |
| Number of days previous month did not get enough rest or sleep    | 9.7   | 15.3     | 13.7  |

\*Respondents who still have asthma.

## Health Results (Cont.)

| Survey Item/Group  | CwT   | T Pre-wx | CWL   |
|--|-------|----------|-------|
| New/more frequent or severe headaches last three months      | 19.3% | 38.6%    | 31.3% |
| Three or more ear infections last year                       | 9.1%  | 13.6%    | 12.7% |
| Any kind of respiratory allergy last year                    | 60.4% | 69.3%    | 71.3% |
| Flu last year  | 18.8% | 21.6%    | 22.0% |
| Persistent cold symptoms lasting more than 14 days last year | 19.3% | 29.5%    | 29.3% |
| Sinus infection or sinusitis last year                       | 40.6% | 60.2%    | 50.0% |
| Bronchitis last year   | 22.3% | 27.3%    | 27.3% |

# Budget Tradeoffs

| Survey Item/Group  | CwT   | T Pre-Wx | CWL   |
|--|-------|----------|-------|
| It is hard or very hard to pay energy bills                    | 50.8% | 76.1%    | 65.4% |
| Did not buy food to pay energy bills                           | 27.4% | 35.2%    | 46.1% |
| Went without food in the last four weeks                       | 5.6%  | 11.4%    | 15.3% |
| Worried household members would not have nutritious food       | 18.3% | 27.3%    | 35.3% |
| Did not fill prescriptions to pay energy bills                 | 23.5% | 35.3%    | 32.7% |
| Past year used pay day loan to pay energy bill                 | 3.6%  | 10.2%    | 6.0%  |
| Past year used tax refund anticipation loan to pay energy bill | 0.5%  | 2.3%     | 5.3%  |
| Past year used car title loan to pay energy bill               | 3.6%  | 5.7%     | 8.7%  |
| Past year used other short term loan to pay energy bill        | 3.6%  | 6.8%     | 8.7%  |
| Past year used pawn to pay energy bill                         | 7.1%  | 3.4%     | 10.0% |
| How often receive a disconnect notice                          | 36.7% | 51.1%    | 59.4% |
| Electricity or NG disconnected past year                       | 8.3%  | 24.4%    | 24.7% |

# Cluster Analysis – T + CWL Groups

| Cluster #                                       | 1                     | 2          | 3     | 4                               | 5         | 6                   |
|---|-----------------------|------------|-------|---------------------------------|-----------|---------------------|
| Cluster Description                             | Food & Medical Issues | Worst Case | Other | Pervasive Bill Trade-off Issues | Best Case | Utility Bill Issues |
| %   | 17%                   | 9%         | 9%    | 12%                             | 36%       | 17%                 |
| Used one or more short-term, high interest loan | 25%                   | 45%        | 9%    | 50%                             | 5%        | 44%                 |
| Paid other utility bills before energy bills    | 3%                    | 64%        | 77%   | 54%                             | 7%        | 15%                 |
| Paid energy bills before other utility bills    | 5%                    | 95%        | 64%   | 50%                             | 6%        | 66%                 |
| Paid energy bills before buying food            | 98%                   | 95%        | 18%   | 79%                             | 4%        | 27%                 |
| Bought food instead of paying energy bills      | 20%                   | 55%        | 0%    | 100%                            | 0%        | 5%                  |
| Household member went without food              | 20%                   | 82%        | 0%    | 7%                              | 4%        | 5%                  |
| Worried that cannot afford nutritious food      | 70%                   | 100%       | 45%   | 39%                             | 6%        | 2%                  |
| Could not afford prescriptions                  | 65%                   | 82%        | 5%    | 50%                             | 14%       | 73%                 |
| Could not afford to see a doctor                | 78%                   | 77%        | 59%   | 21%                             | 8%        | 61%                 |
| Received food assistance (e.g., WIC)            | 38%                   | 45%        | 23%   | 75%                             | 42%       | 59%                 |
| Avg. # Issues Pre-Wx                            | 4.2                   | 7.4        | 3.0   | 5.2                             | 0.95      | 3.4                 |

# Demographics by Cluster

| Variable/Cluster   | KEEM Best | KEEM Worse |
|--|-----------|------------|
| Age of Respondent  | 57.5      | 52.6       |
| Respondent Employed  | 38.9%     | 31.8%      |
| Respondent Retired   | 30.6%     | 9.1%       |
| Respondent Unable to Work                                      | 22.4%     | 50.0%      |
| Home Sometimes at Unhealthy Temp                               | 35.3%     | 63.6%      |
| Used Oven to Heat Home Past 12 months                          | 10.6%     | 18.1%      |
| Evidence of Insect Infestation                                 | 28.2%     | 45.5%      |
| Evidence of Pest infestation                                   | 25.9%     | 31.8%      |
| Seen Mold in Home  | 37.6%     | 40.9%      |
| Number of Days Previous Month Physical Health Not Good         | 8.4       | 16.8       |
| Number of Days Previous Month Mental Health Not Good           | 5.0       | 16.0       |
| Number of Days Previous Month Did Not Get Enough Rest or Sleep | 11.1      | 19.6       |
| Bronchitis Last Year   | 20.0%     | 31.8%      |
| New/more Frequent or Severe Headaches Last Three Months        | 23.5%     | 36.4%      |
| Flu Last Year  | 16.5%     | 50.0%      |
| Persistent Cold Symptoms Lasting More Than 14 Days Last Year   | 22.4%     | 36.4%      |
| Sinus Infection or Sinusitis Last Year                         | 47.1%     | 72.7%      |

# Comparing KEEM Results to DOE's Weatherization Assistance Program (WAP) Evaluation Results

- As part of the WAP evaluations, a nationally representative set of single family and mobile homes were administered an extremely similar phone survey.
- A higher proportion of KEEM households are African American.
- The KEEM households were in worst condition pre-Wx.
- The KEEM households have higher rates of respiratory-related health problems.
- The KEEM households also have higher rates of adverse budget issues.
- A similar percentage of households fell into the best and worst clusters and had same demographics.

## Research Next Steps

- Complete database that contains measures installed and Wx job costs for the CwT and T groups.
- Re-survey the T and CWL groups in spring/summer 2018.
- Acquire energy savings estimates for CwT and T based on the analysis of weather normalized utility bills.
- Estimate changes of health attributable to KEEM (using T and CWL groups).
- Monetize a subset of these benefits (e.g., asthma).
- Conduct explanatory factors analysis to attribute changes in health attributable to specific and/or packages of weatherization measures.
- Explore health benefits deriving from direct and indirect changes in household budgets from energy cost savings.

# Future Research Opportunities

- Explore the persistence of health benefits over time.
- Estimate health impacts that require years to manifest.
- Explore transfer of health benefits to successive occupants of weatherized homes.
- Collect medical cost data over time.
- Estimate the benefits of weatherizing affordable multifamily buildings.
- Explore the health benefits of weatherization in unique contexts (e.g., in the presence of wildfires).



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