Combining Health Literacy Tools & Computer Programing Tools to Create Accessible, Individualized Report-Backs

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CRESSH

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HOME Study

"How do housing characteristics and resident behavior affect indoor air quality, noise, and thermal comfort?"

- Chelsea (2018) & Dorchester (2020), MA
- Winter and Summer season monitoring
  - 1 week each

- Questionnaire
- Visual Assessment
- Indoor Measurements
  - NO
  - NO_2
  - CO
  - $PM_{2.5}$
  - Temp/ relative humidity
  - CO2
  - Noise
  - VOCs

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Background

Approach

- Streamline the process of report back for research teams
- Improve the accessibility of report back materials for readers

Presentation Goals

- Actionable tools for data communication
  - Part 1: Data compilation
  - Part 2: Reader accessibility

Part 1:
Data Compilation
Macro Data Compilation Tool

Part 2:
Reader Accessibility
Health Literacy Tools to Template

Challenges of Reporting Back Data to Participants

Generating Reports

- Time and resource intensive. Prone to human error.

- Presenting individualized results is limited by logistical burden of tailoring report backs.

- Tailored communication becomes increasingly time-intensive in proportion to a study's complexity.

User Accessibility

- Participants prefer tailored messaging

- Environmental health literacy (EHL) concepts and tools still under development
    - How do we ensure material accessibility using validated tools or research-driven evidence?

MCR: Macro for the Compilation of Report-backs

- Flexible and scalable method for compiling individual reports

- Macro-enabled Excel workbook containing Microsoft Visual Basic for Applications (VBA) script

- Generalizable and open-source (available soon on GitHub)

MCR: How does it work?

1. Create template (Word or Powerpoint)
2. Generate participant text and graphic outputs
3. Compile data into a single master Excel file
4. Run MCR
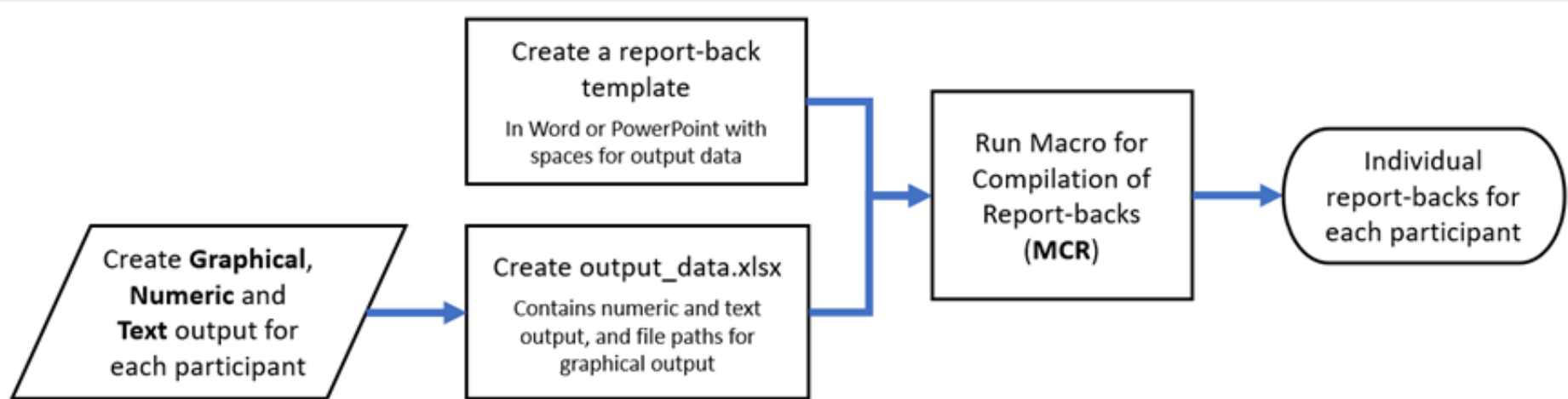
Polka et al., 2021 (in preparation)

MCR: What does it do?

- Insert participant data into templates and compile individualized reports

- Participant data can be **numerical**, text, or graphics

Template

Your Home	All Homes in Dorchester
Warm Season	
{avg_NO2_S}	14
Cold Season	
{avg_NO2_W}	11

Finished Product

Your Home	All Homes in Dorchester
Warm Season	
<1	14
Cold Season	
4	11

MCR: What does it do?

- Insert participant data into templates and compile individualized reports

Question to think about:

{NO2_seasonal_text}

- ❑ We cook with our stove or oven
- ❑ We rely on natural gas heating
- ❑ We smoke inside
- ❑ We open the windows less

Finished Product

- Participant data can be numerical, **text**, or graphics

Question to think about:

Results for NO2 in your home were higher in the Cold season than the Warm season. Your Cold season had a seasonal average of 42 ug/m3, which is higher than the WHO indoor guideline. Check any of the below activities that you do more in the Cold season that could increase your indoor air NO2 levels:

- ❑ We cook with our stove or oven
- ❑ We rely on natural gas heating
- ❑ We smoke inside
- ❑ We open the windows less

MCR: What does it do?

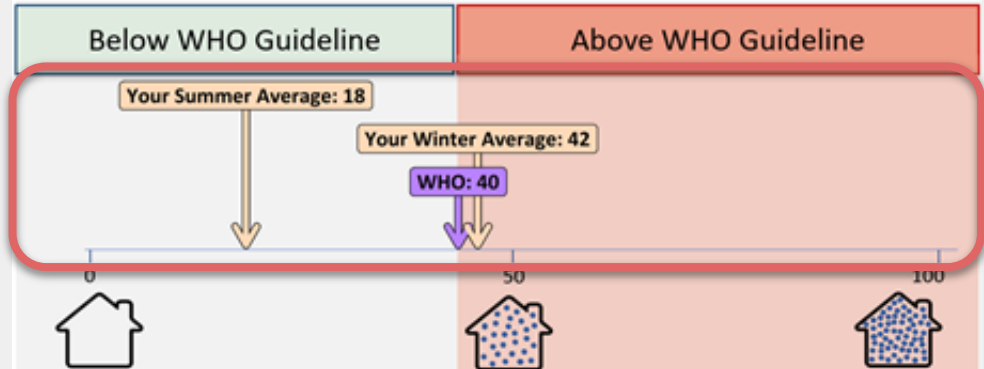- Insert participant data into templates and compile individualized reports

- Participant data can be numerical, text, and /or **graphics**

Template

Below WHO Guideline	Above WHO Guideline

0   50   100

Finished Product

Below WHO Guideline	Above WHO Guideline

Your Summer Average: 18

Your Winter Average: 42

WHO: 40

0   50   100

MCR In Practice

- MCR was piloted in two environmental exposure studies in MA

- Interviewed 7 team members

- Summarized the challenges and benefits of using MCR in compiling reports back to study participants

Findings

- Efficient - speeds up the compilation process of report-backs

- Increased individualization

- Promotes design creativity

- Reduces potential for human error

- Increased confidence in report-back control

MCR Applications

- Improved engagement opportunities

- Facilitates easier communication of strengths and uncertainties

- Increased engagement opportunities among participants and community partners

- Increased accessibility of environmental health materials

- Generalizable with opportunities for scaling up

Accessing MCR

- Publication: Polka et al., MCR: Open-source Software to Automate Compilation of Health Study Report-back. 2021. [in preparation]

- Upcoming: Access online at GitHub

- Contact for questions or to be added to our distribution list:
  - Chad Milando, PhD: cmilando@bu.edu

Part 1:
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Part 2:
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Creating an Accessible Template

Informed by:
1. Formative research with study participants via semi-structured interviews (n=20)
2. State of the literature for research including data report-back
3. Evidence-based health literacy tools

Rigorous Assessment:
4. Overall accessibility and suitability review (CDC Index)
   a. Reviewed by multiple members of research team

Report Back Material Goals

1. Provide individual household data back to participants in a way that is <u>accessible</u> for our audience

1. Provide recommendations to participants for ways to improve their indoor air quality that is <u>actionable, and builds self-efficacy</u>

Goal 1: Accessibility

Gist-Level

Verbatim-Level

CRESSH HOME — Summary of Your Particulate Matter Results

What is Particulate Matter?
Particulate matter ($PM_{2.5}$) is tiny particles that float in the air. The particles are 30 times smaller than the width of a hair. They can be hard to see, but if there are enough of them they can be seen.

What are the health impacts?
$PM_{2.5}$ can increase the risk of heart disease, asthma, heart conditions, and eye or ear irritation. There are steps you can take in your home to lower your $PM_{2.5}$ and health risks.

Where does Particulate Matter come from in the home?
$PM_{2.5}$ comes from burning things.
Smoking, cooking, burning candles, or room sprays can create $PM_{2.5}$.

Your Home's Average Indoor $PM_{2.5}$ Results (concentration in $\mu g/m^3$)

If your results are within this range, you can still lower your levels or avoid future high levels by trying ideas on page 17

If your results are within this range, we suggest trying some ideas on page 17

Your Summer Average: 7
Your Winter Average: 23
Health Guideline: 10

0   50   100

Less Indoor $PM_{2.5}$ In Your Home & Least Health Risk

More Indoor $PM_{2.5}$ In Your Home & More Health Risk

* Red dots represent indoor $PM_{2.5}$

- Your home's average indoor $PM_{2.5}$ concentration in the warm season was 7 $\mu g/m^3$.
- Your home's average indoor $PM_{2.5}$ concentration in the cold season was 23 $\mu g/m^3$.
- Your home was above the World Health Organization's indoor guideline for $PM_{2.5}$ in one season. Try some of the ideas to lower your $PM_{2.5}$ on page 17.
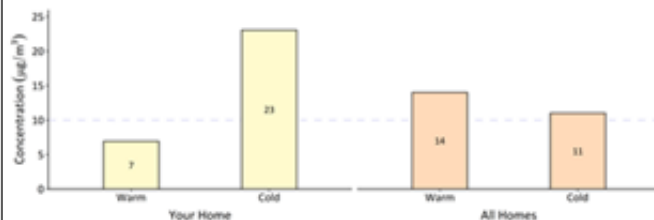
CRESSH HOME — Your Home's Seasonal Particulate Matter Results

Your Seasonal Particulate Matter ($PM_{2.5}$) Indoor Results

The table and graph below show the same data. They show how your average indoor air quality compares to the rest of your neighborhood and the WHO indoor guideline for $PM_{2.5}$.

Seasonal Indoor Particulate Matter ($\mu g/m^3$)		
WHO Indoor Guideline	Your Home	All homes in Dorchester
	Warm Season	
10	7	14
	Cold Season	
	23	11

Question to think about:
Results for $PM_{2.5}$ in your home were higher in the cold season than the warm season. Your cold season had a seasonal average of 23 $\mu g/m^3$, which is higher than the WHO indoor guideline. There may be things that you do in your home during the cold season more often than in the warm season that could increase your indoor air $PM_{2.5}$ levels. Check any of the below activities that you do more in the cold season that could increase your indoor air $PM_{2.5}$ levels:

- ❏ We cook with our stove or oven
- ❏ We use air fresheners
- ❏ We burn candles
- ❏ We smoke inside
- ❏ Not sure
- ❏ Other (please list): _____

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Tool 1: SMOG (Literacy Demand)

Focus: word & sentence length

- Calculation based on number of polysyllabic words, sentence length

Output: numerical score/reading grade level of text

Pros:

- Well-suited to health materials
    i. More recent validation criteria for grade level estimate
    ii. High consistency in results
- Correlates with tests of reading comprehension
- Low input to assess readability

Tool 1: SMOG (Literacy Demand)

Application:
1. Identify 30 sentences
2. Highlight all polysyllabic words
3. Use formula to calculate reading level

Outcome:
- Reduced reports' literacy demand
  - 13th → 7th grade level

Your Home's Particulate Matter Results

This section of the packet contains your home's measured particulate matter ($PM_{2.5}$) results. The data are shown in a few ways: an overview of your home's results, your home's results for the warm and cold seasons, and your home's daily results. Each of these sections is explained below.

1: Overview of Your Home's Particulate Matter Results

This section explains what $PM_{2.5}$ is, where it comes from, and possible health impacts. It also compares your measured $PM_{2.5}$ levels to all homes measured in Dorchester and to the World Health Organization's Indoor Guideline for $PM_{2.5}$.

Tool 2: PMOSE/IKIRSCH (Document Complexity)

Focus: format & structure of documents

- ○ Structure

- ○ Density

- ○ Dependency

Outputs:

- ○ Score for structure

- ○ Associated grade-level range for suitability match

Tool 2: PMOSE/IKIRSCH

Application:
1. Determine **structure** (type of document) and score
2. Determine **density** of document and score
3. Determine **dependence** and score.
4. **Sum** all scores
5. Determine complexity using chart

Outcome:
- Reduced reports' structure/layout complexity
  - 8th → 4th grade level

CRESSH HOME

Your NO$_2$ Results

Nitrogen Dioxide (NO$_2$):
NO$_2$ is a gas formed when two oxygen molecules and one nitrogen molecule bond to each other. There are other types of molecules that combine N and O, but this specific type of air pollutant is often called "NOx". The primary source of NOx is the burning of fuel (e.g., cars, trucks).

The table below shows the average measurements for the two weeks that you participated in the study, one week in the warm season and one week in the cold season, as well as regulatory and guideline levels for comparison. Reading from left to right, these values include the average amount of NO$_2$ measured inside your home over those two weeks and the weekly average for all homes in Dorchester in each season. The next column to the right are weekly NO$_2$ averages we collected from Chelsea, MA. The table also includes daily averages from other studies that measured indoor NO$_2$ concentrations in East Baltimore and Los Angeles as well as the World Health Organization (WHO) annual indoor air guideline (40 µg/m^3) that you can use for comparison. Finally, the table shows the average outdoor measurements for the same warm and cold season weeks in Dorchester and the EPA annual outdoor standard (100 µg/m^3). As a reminder, the lower the concentration the better the air quality.

All numbers in the table represent measures of µg/m^3

NO$_2$									
Indoor (ug/m^3)						Outdoor (ug/m^3)			
Your Home	All homes in Dorchester	Chelsea, MA	East Baltimore, MD*	Los Angeles, CA**	WHO Indoor Guideline	Your Home	All homes in Dorchester	Chelsea, MA	EPA Annual Standard
Warm Season						Warm Season			
29	26	37	56	51	40	12	10	123	100
Cold Season						Cold Season			
42	31	56				16	15	73	

*Hansel et al. 2008, Environ Health Perspect | **Spengler et al. 1994, Air and Waste
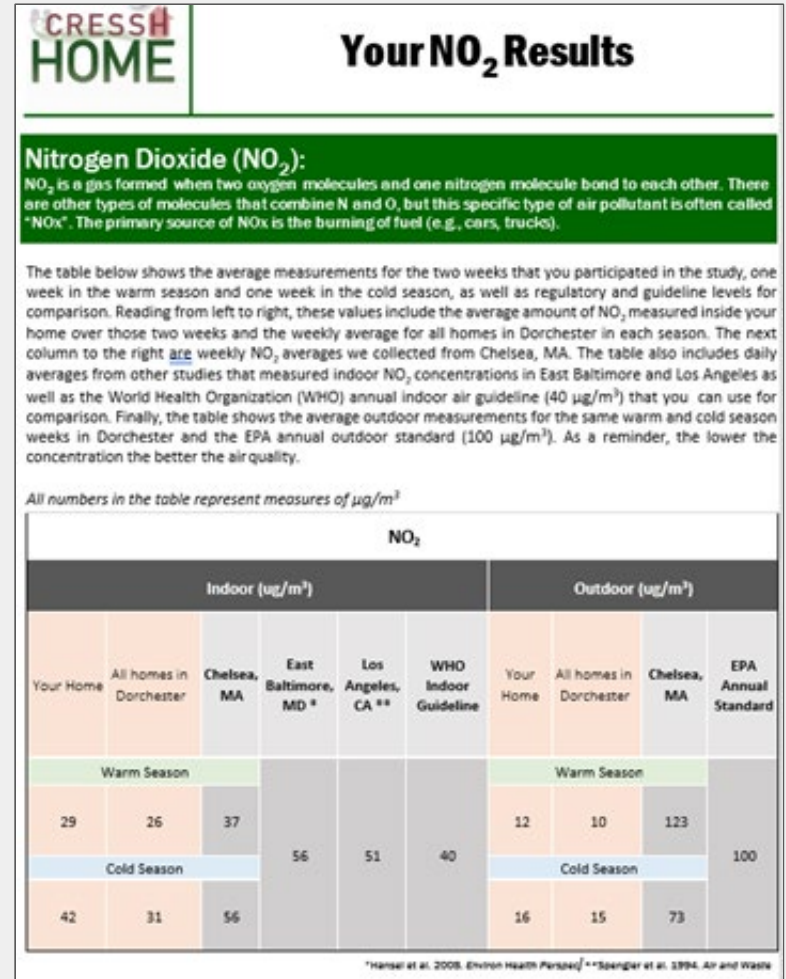
25

Tool 2: PMOSE/IKIRSCH

Application:
1. Determine **structure** (type of document) and score
2. Determine **density** of document and score
3. Determine **dependence** and score.
4. **Sum** all scores
5. Determine complexity using chart

Outcome:
- Reduced reports' structure/layout complexity
  - 8th → <u>4th</u> grade level

Your Home's Nitrogen Dioxide Results

Nitrogen Dioxide (NO₂):
NO₂ is a gas that comes from burning fuels. NO₂ cannot be seen or smelled. Inside homes, the main source of NO₂ comes from using a gas stove or oven. Using a stove vent or opening a window while you cook can help lower your indoor NO₂. Lowering your NO₂ can help avoid health impacts like coughing, wheezing, colds, and lung irritation.

Your Indoor Nitrogen Dioxide

The first table below shows (from left to right):
- The average **indoor** NO₂ levels in **your home** during the two weeks that you participated in the study for both warm and cold seasons.
- The average **indoor** NO₂ levels in **all homes** in Dorchester during both warm and cold seasons.
- The **World Health Organization (WHO) Indoor Health Guideline** for NO₂. This is not legally enforceable.

All numbers in these tables represent measures of μg/m³

Your Home	All Homes in Dorchester	WHO Indoor Guideline
Warm Season		
21	26	40
Cold Season		
17	31	

Your Outdoor Nitrogen Dioxide

The table below shows (from left to right):
- The average **outdoor** NO₂ levels in Dorchester during both warm and cold seasons.
- The **Environmental Protection Agency (EPA) Annual Standard** for NO₂. This is legally enforceable.

All numbers in these tables represent measures of μg/m³

| Outdoors in Dorchester	EPA Annual Standard
Warm Season	
10	100
Cold Season	
15	

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Tool 2: PMOSE/IKIRSCH (Document Complexity)

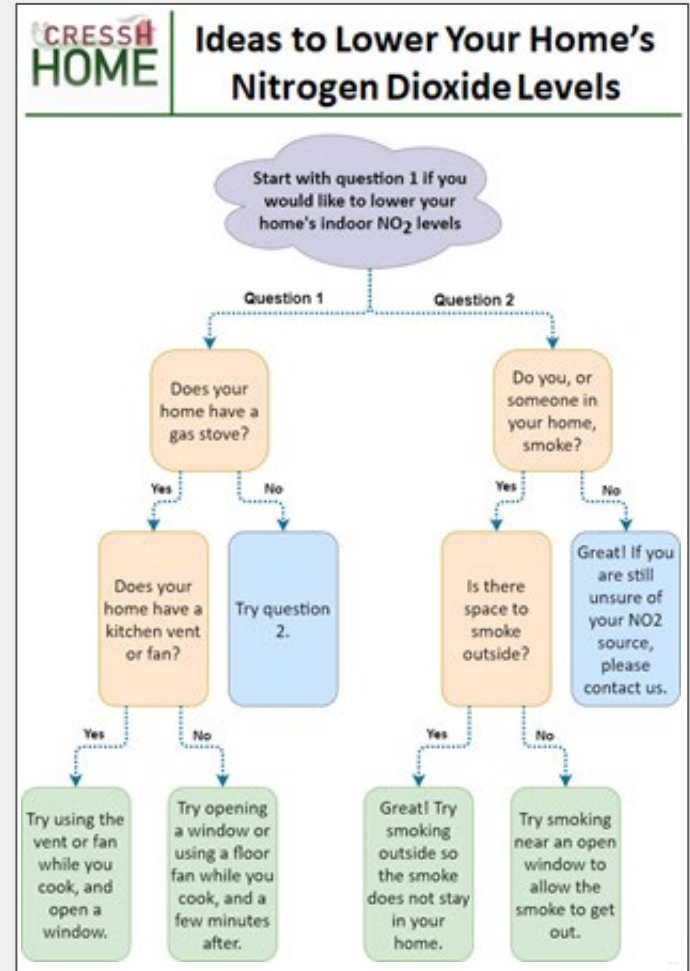| Scores	3 4 5	6 7 8	9 10 11	12 13 14	15 16 17
Complexity level	Very low	Low	Moderate	High	Very High
Proficiency Level	Level 1	Level 2	Level 3	Level 4	Level 5
Grade / Schooling	Range includes Grade 4 or less than 8 years of schooling	Range includes grade 8 or high school degree	Range includes grade 12 or some education after high school	Range includes 15 years of schooling or college degree	Range includes 16 years of schooling or post college

Goal 2: Actionability

Goal 2: Self-Efficacy & Actionability

- Range of solutions/actions

- Individualized report text & graphics, with direct actions suggested based on exposure concentrations
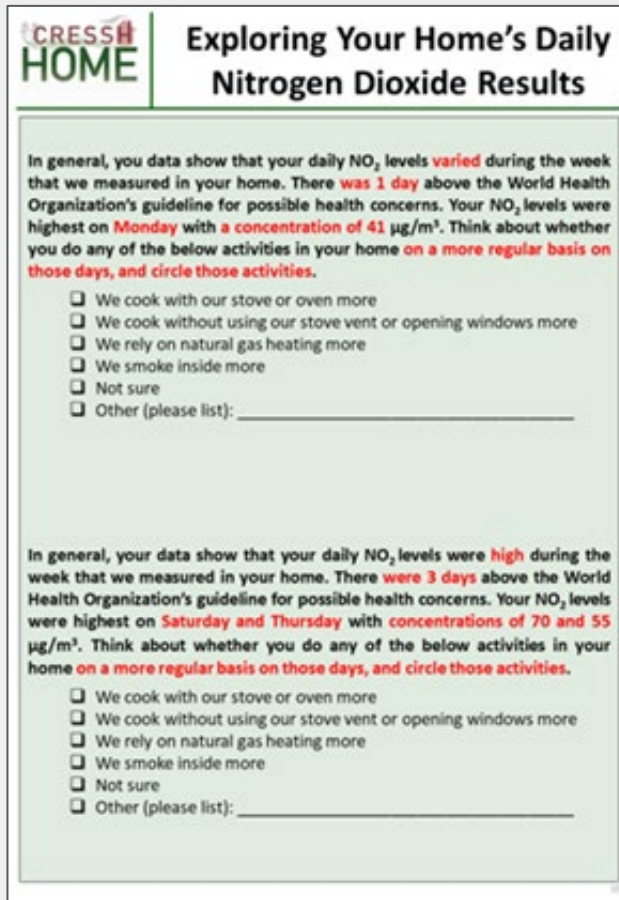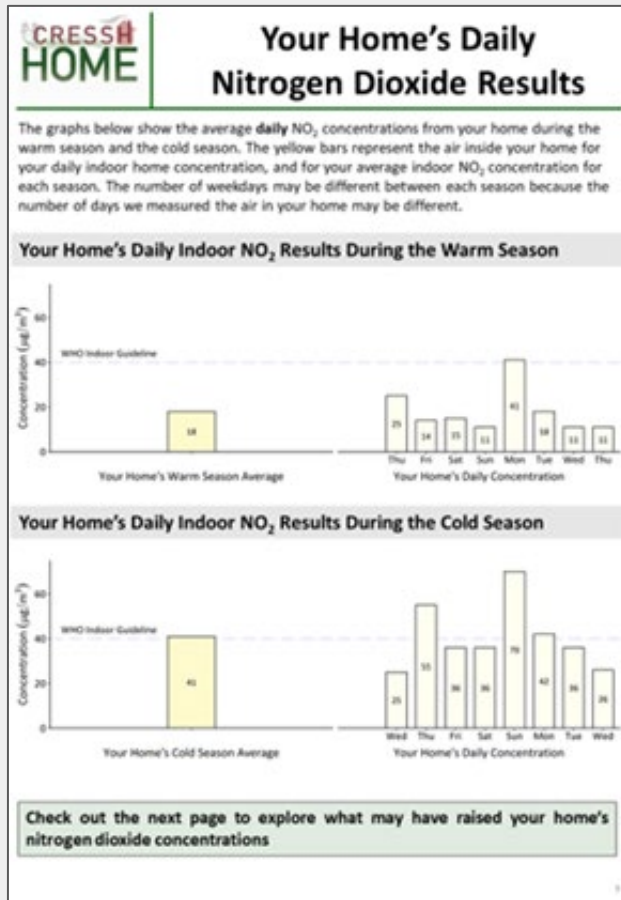
Goal 2: Self-Efficacy & Actionability

- Report focused on building self-efficacy & engagement
  - Workbook style with small, manageable steps

- Guidance from participant interviews

Ideas to Lower Your Home's Nitrogen Dioxide Levels

CRESSH HOME

Start with question 1 if you would like to lower your home's indoor NO_2 levels

Question 1 — Does your home have a gas stove?
- Yes → Does your home have a kitchen vent or fan?
  - Yes → Try using the vent or fan while you cook, and open a window.
  - No → Try opening a window or using a floor fan while you cook, and a few minutes after.
- No → Try question 2.

Question 2 — Do you, or someone in your home, smoke?
- Yes → Is there space to smoke outside?
  - Yes → Great! Try smoking outside so the smoke does not stay in your home.
  - No → Try smoking near an open window to allow the smoke to get out.
- No → Great! If you are still unsure of your NO2 source, please contact us.

Assessment of Template

Assessment of Final Template

CDC Clear Communication Index

1. Main message and call to action
2. Language
3. Information design
4. State of the science
5. Behavioral recommendations
6. Numbers
7. Risk

Scores of 90/100 or above are 'passing'

3 team members applied CDC Index

Previous Page

CDC Clear Communication Index Score Sheet

Calculate the Score for the Material

- **Step 1:** The total points that the material earned (this is the numerator).
  - » A: __10__ B: __3__ C: __3__ D: __3__ = __19__
- **Step 2:** The total possible points that the material could have earned (this is the denominator).
  - » A: __11__ B: __3__ C: __3__ D: __3__ = __20__
- **Step 3:** The numerator divided by the denominator multiplied by 100 to get the total score.

$$ \underline{\quad 19 \quad} / \underline{\quad 20 \quad} \times 100 = \underline{\quad 95.0 \quad} $$

How to Interpret the Score

The purpose of the Index is to improve the clarity of communication products.

If the total score is 90 or above:

Excellent! You have addressed most items that make materials easier to understand and use.

If the total score is 89 or below:

Note which items scored 0 points. Use the descriptions and examples in the User Guide to revise and improve the material. Then apply the Index again to check your work. You can use the Index as many times as you need to revise the material to get a score of 90 or above.

Additional Comments

Benefits of Macro Tool in Concert with Health Literacy Tools

- Reallocate researcher time and effort from report back compilation to health literacy, accessibility, and design improvements

  - Facilitates easier adjustments

- Can adjust for participant variation in graphics and text

  - Increased tailoring of content can help link information on exposure, behaviors, and suggested actions

Accessing Health Literacy Tools

To access the health literacy tools:

SMOG : https://cdn1.sph.harvard.edu/wp-content/uploads/sites/135/2012/09/smogoverview.pdf

PMOSE/IKIRSCH:

https://www.jstor.org/stable/40016961?seq=1

CDC Clear Communication Index:

https://www.cdc.gov/ccindex/pdf/ClearCommUserGuide.pdf

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National Institute of Environmental Health Sciences
Your Environment. Your Health.

EPA United States Environmental Protection Agency

BU Boston University School of Public Health

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Thank you