“Green” vs. Conventionally Built Housing: an Environmental Comparison

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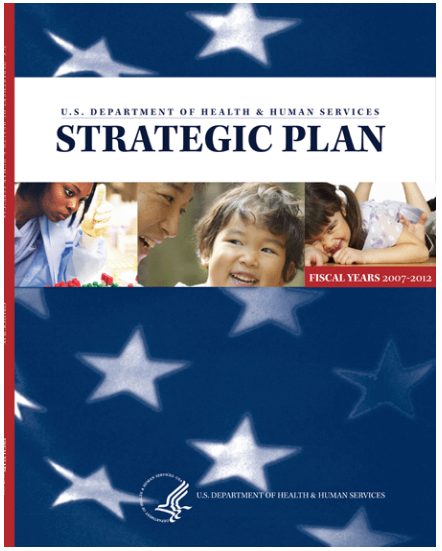
September 2008

Background

Public Health Goals



DHHS Strategic Plan *2007 -2012*

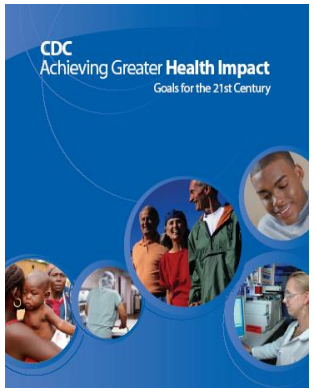
Protect Life, Family, and Human Dignity

Background

Healthy People 2010

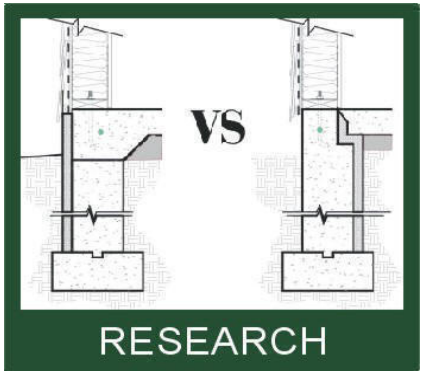
CDC Health Protection Plan

Healthy People in Healthy Places



Aim of Study

- Assumption: Green building design reduces allergens and toxic substances within the home.
- Goal: to obtain science-based evidence of the benefits of green vs. conventional building.



- Specific goal: to pilot the methodology for a national study of health effects and possible economic benefits of “Green” vs. conventionally constructed housing.

Study Green Criteria

- Advanced Framing
- Fresh Air Intake
- Right-size HVAC (Manual J Calc)
- Moisture Protection Measures
- Energy Star Appliances
- Recycled Content Products
- Waste Management

Methodology

- Objective: To quantify levels of allergens, fungi, pesticides and volatile organic chemicals in “green” and conventionally built housing.

- Hypothesis: There is a difference in exposures to select allergens, fungi, pesticides, and volatile organic chemicals between “green” and conventionally built housing.

Methodology - Demographics

- Study Design - Cross-sectional
- Sample – Convenience, Atlanta
  - 2 Senior-citizen independent housing complexes

- Green complex
  - Built in 2003
  - 84 units
- Residents
  - age: 64-90
  - n = 33

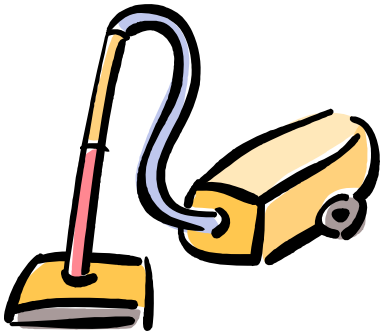
- Conventional complex
  - Built in 1978
  - 195 units
- Residents
  - age: 55-97
  - n = 40

Methodology (cont'd)

- Data Collection
  - Interviews: participants, property managers
  - Maintenance records – units and property
  - Visual assessments of units
  - Environmental sampling
  - List of household cleaning products

Methodology (cont'd)

Environmental Sampling

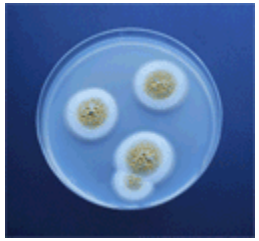


- Allergens and fungi
  - Vacuum dust
- Pesticides
  - Isopropanol wetted gauze
- Aldehydes and VOCs
  - Passive air diffusion badges

Methodology (cont'd)

Environmental Sampling

- Allergens
  - Dust mites Der p 1
    Der f 1
  - Cockroach Bla g 2
  - Rat Rat n 1
  - Mouse Mus m 1
- Culturable Fungi

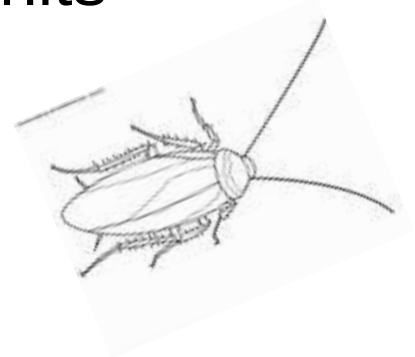


- Volatile Organic Chemicals
  - Formaldehyde
  - Acetaldehyde
  - Other
- Pesticides
  - Chlorpyrifos
  - Cypermethrin
  - Additional pesticides

RESULTS

Allergens – Cockroach

- Cockroach allergen
  - “Green”: 2/31 units (6%)
  - Conventional: 0/34 units



Mouse and Rat Allergens

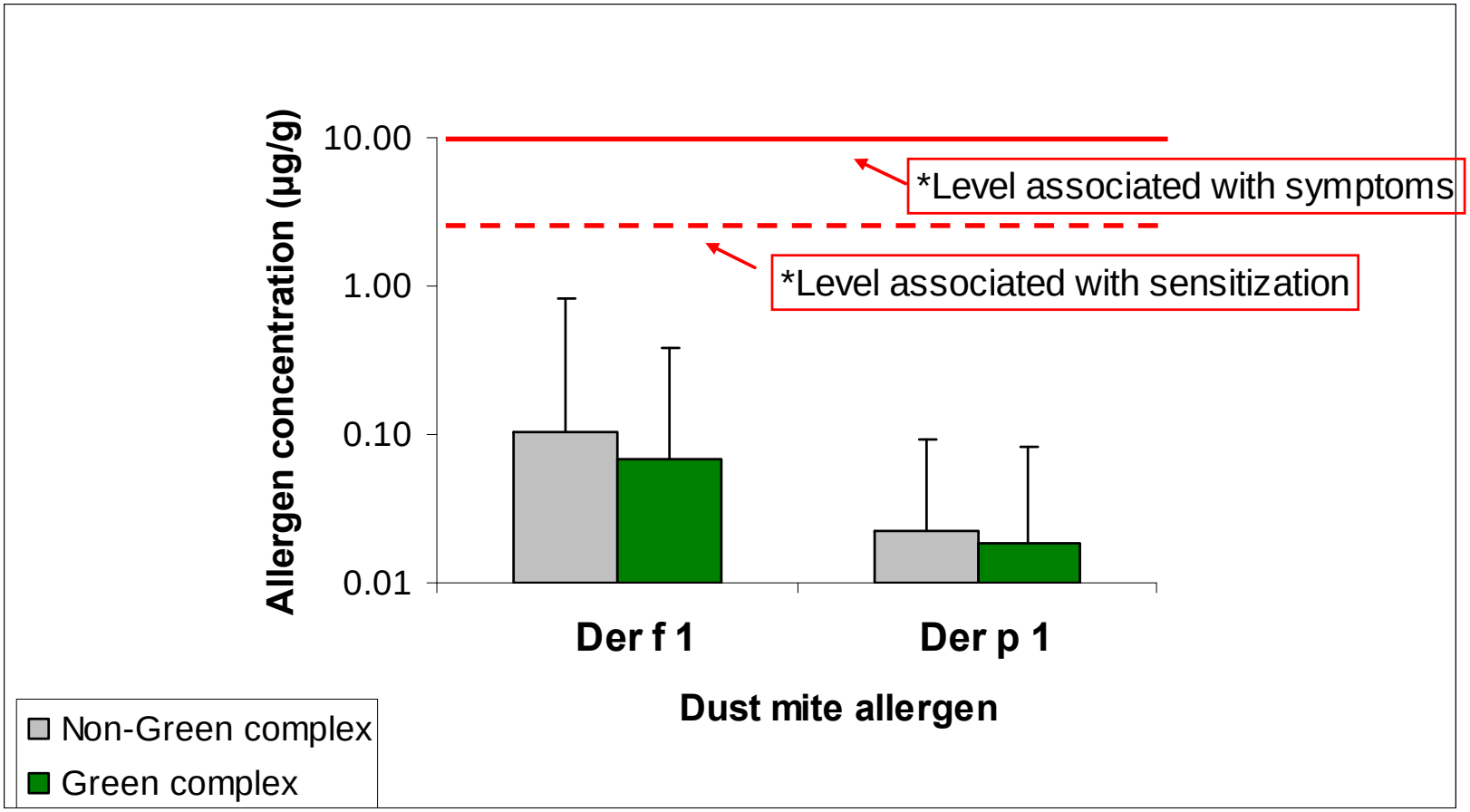
- Mouse (Mus m 1)
  - “Green” 7 of 31 units (23%)* (chisq p =0.07)
  - Conventional 2 of 34 units (6%)
- Rat (Rat n 1)
  - “Green” 1/31 units (3%)
  - Conventional 0/34 units

- Pest Management, Building Layout, Location

Dust Mite Allergens

- Of all homes, 85% had detectable Der p 1 or Der f 1
- Der f 1 was the predominant dust mite allergen.
  - Detectable Der p 1 = 43% (28/65)
  - Detectable Der f 1 = 83% (54/65)

Dust Mite Allergens



*Concentration displayed on log scale.
**Error bars represent 1 unit increase in geometric standard deviation.

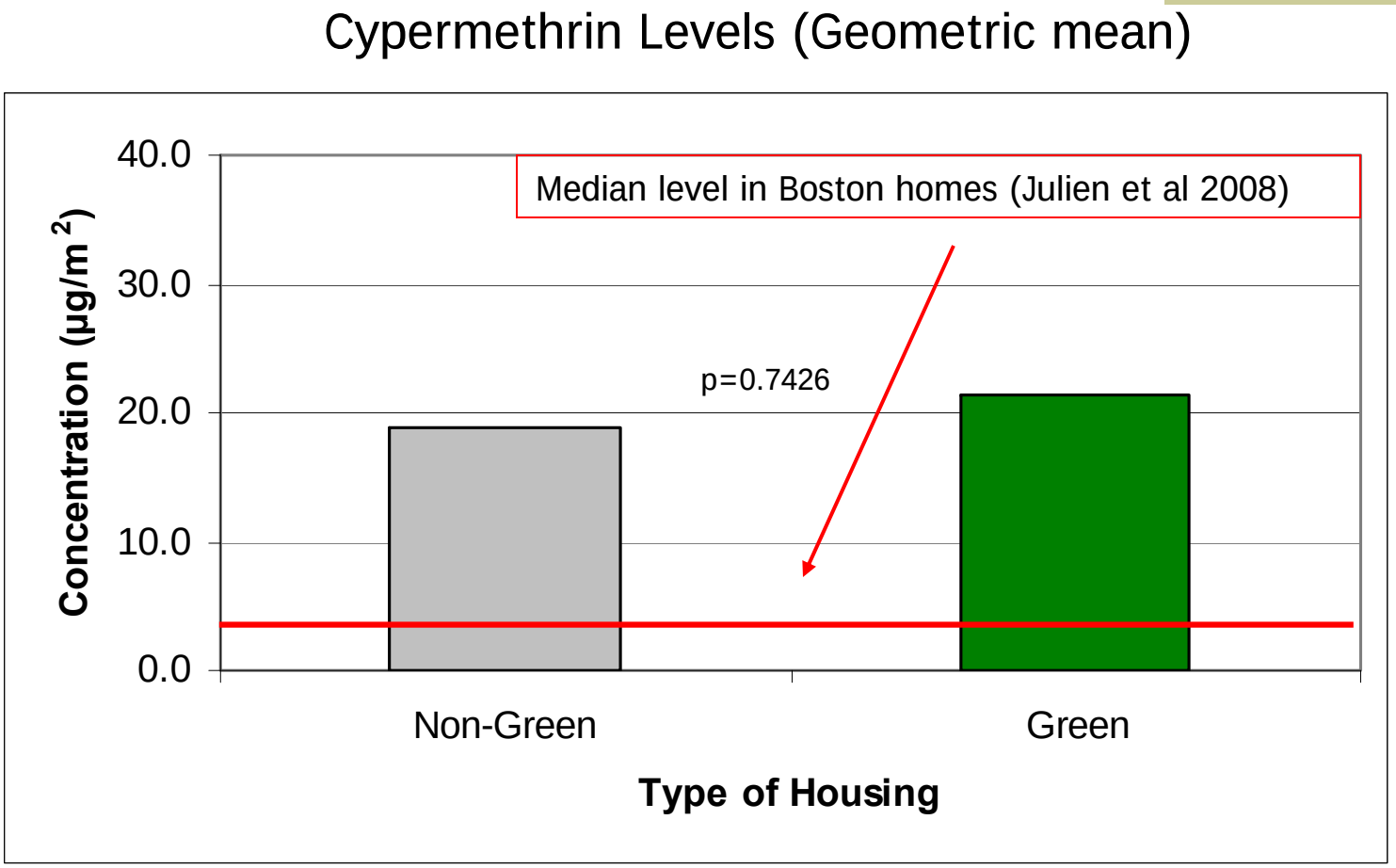
Indoor Allergen Levels

National Survey of Lead and Allergens in Housing

- **Dust mite allergen – detected in 84% of homes**
- **Cockroach allergen – detected in 63% of homes**
- **Mouse allergen – detected in 57% of homes**

*Study conducted by NIEHS and HUD

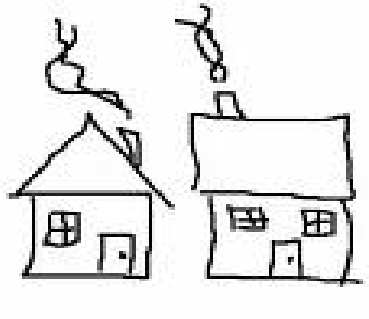
Pesticides

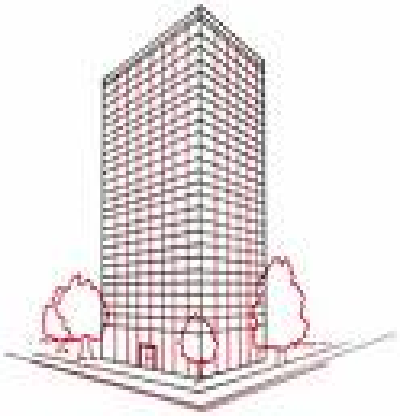


- Chlorpyrifos – Found in 6 conventional units.
- Banned in 2000 for homeowner use.

Limitations, Challenges

- Difficulty obtaining control group
- Disparate age, layout of housing
- Data collection inconsistencies



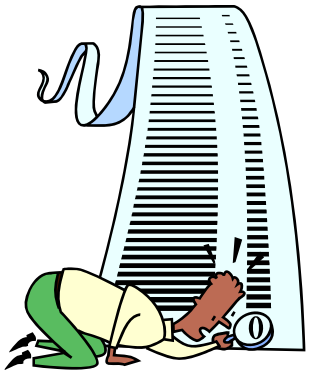


Result Reporting

- Meet with property managers
- Town Hall Meeting
  - explain aggregate results
- Separate responses
  - ambient / below threshold
  - require follow-up
- Offer health resources

Lessons Learned

- Obtain housing – meet with decision-maker
- Ample training time for reinforcement
- Strong communications with investigators
- Pilot questionnaire/sampling in homes
- Close oversight of labeling



Collaboration

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Green Housing Study Team Members

“Green” vs. Conventionally Built Housing: an Environmental Comparison

Acknowledgment

We wish to express our thanks to the
Department of Housing and Urban Development
for the funds to make this pilot possible,
and to
Ginger Chew, ScD, CDC
and
Peter Ashley, DrPH, HUD
for their assistance and valuable input.

BUILDING A FRAMEWORK FOR HEALTHY HOUSING

The Public Health Impact of Greening Affordable Housing

Presented by Jill Breysse

National Center for Healthy Housing

2008 National Healthy Homes Conference ❖ September 15-17, 2008 in Baltimore, MD

Project Partners

Research Team

- National Center for Healthy Housing (NCHH)
- Center for Sustainable Building Research (CSBR)
- Southwest Minnesota Housing Partnership
- Greater Minnesota Housing Fund

Research Funding

- US Environmental Protection Agency
- Enterprise Community Partners
- Blue Cross Blue Shield Foundation of Minnesota

Pre-Rehab Building Description

- Worthington, MN
- Mostly subsidized rentals
- 60 units in 3 buildings
- Constructed in 1974

Before and After Renovation

Green Rehab Elements

- Low-VOC adhesives, paints & coatings
- Radon testing pre- and post-rehabilitation
- Ventilation: ASHRAE 62.2
- Pest management: Contracted with firm specializing in IPM
- Non-smoking common areas
- No carpet in wet areas
- Energy-Star fans exhausted to exterior equipped w/humidistat

Kitchen Renovations

Community Amenities

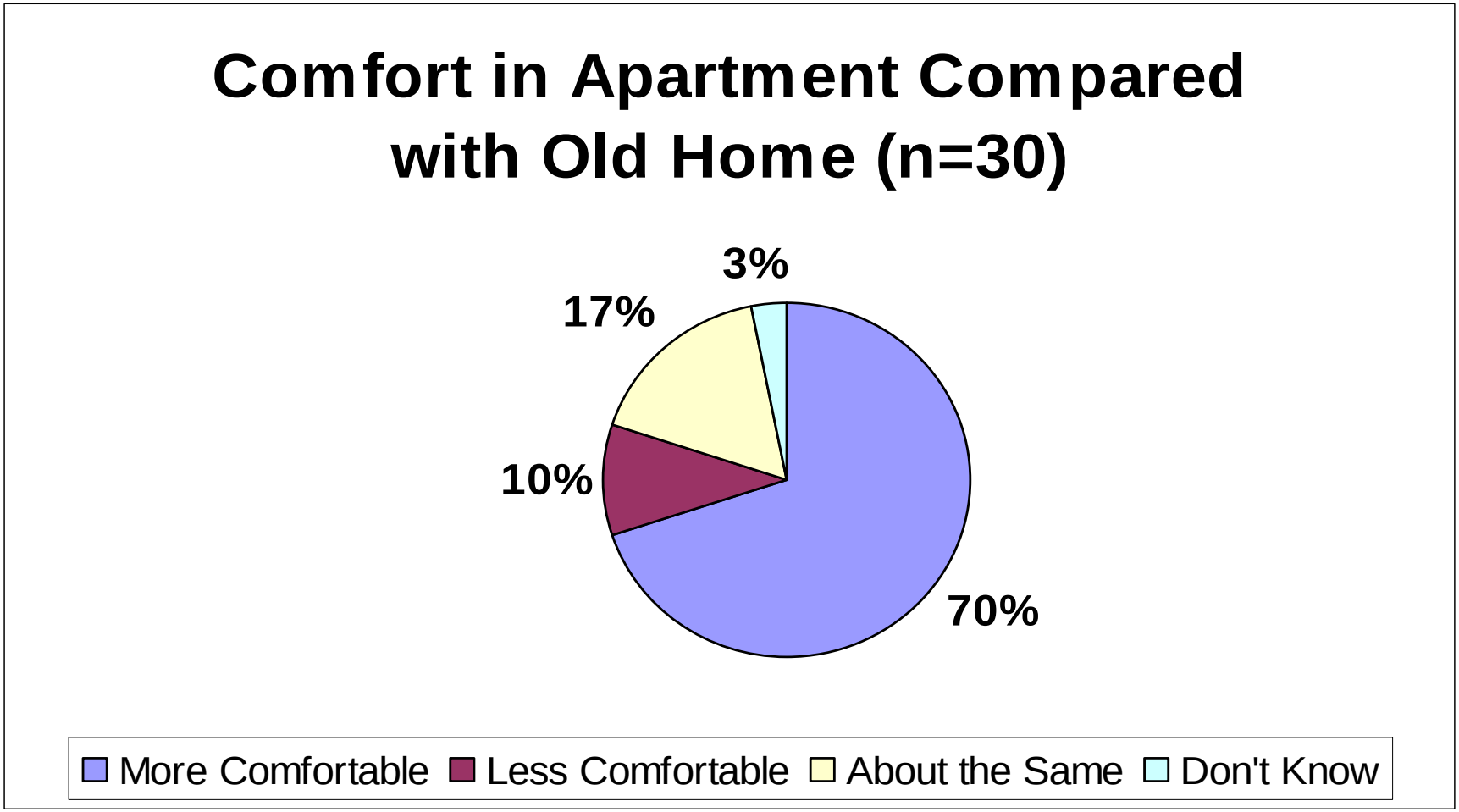
Data Collection and Training

- Health Questionnaire
- Visual Assessment
- Resident Training
- Building Performance Testing
- Radon Testing

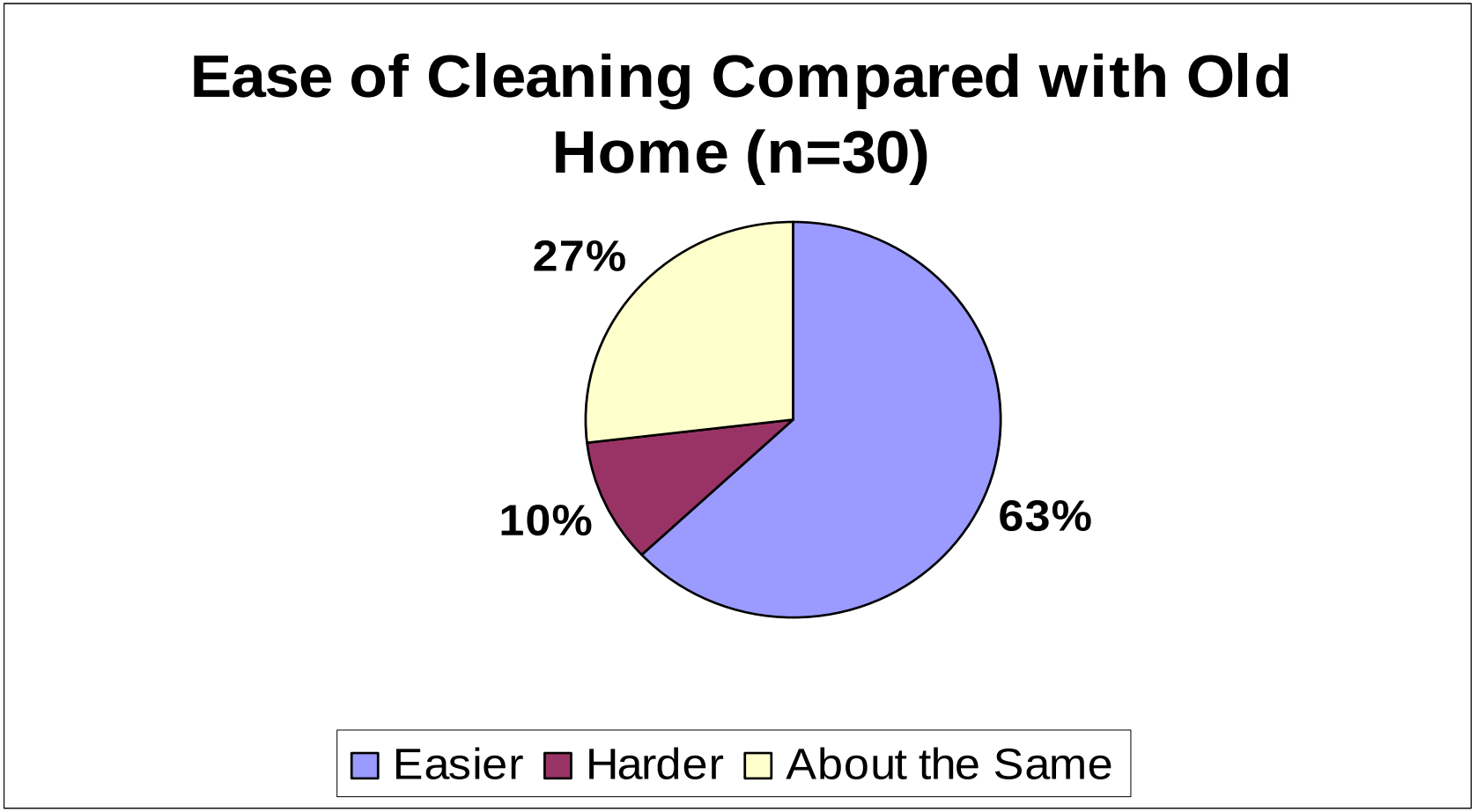
Resident Characteristics

- Winter celebration
- 30 of 54 occupied units enrolled
- 29 adults, 30 children
- Residents in 18 units had lived in renovated apts <1 month; 12 lived there 2 to 9 months
- 6 adults & 2 children w/history of asthma

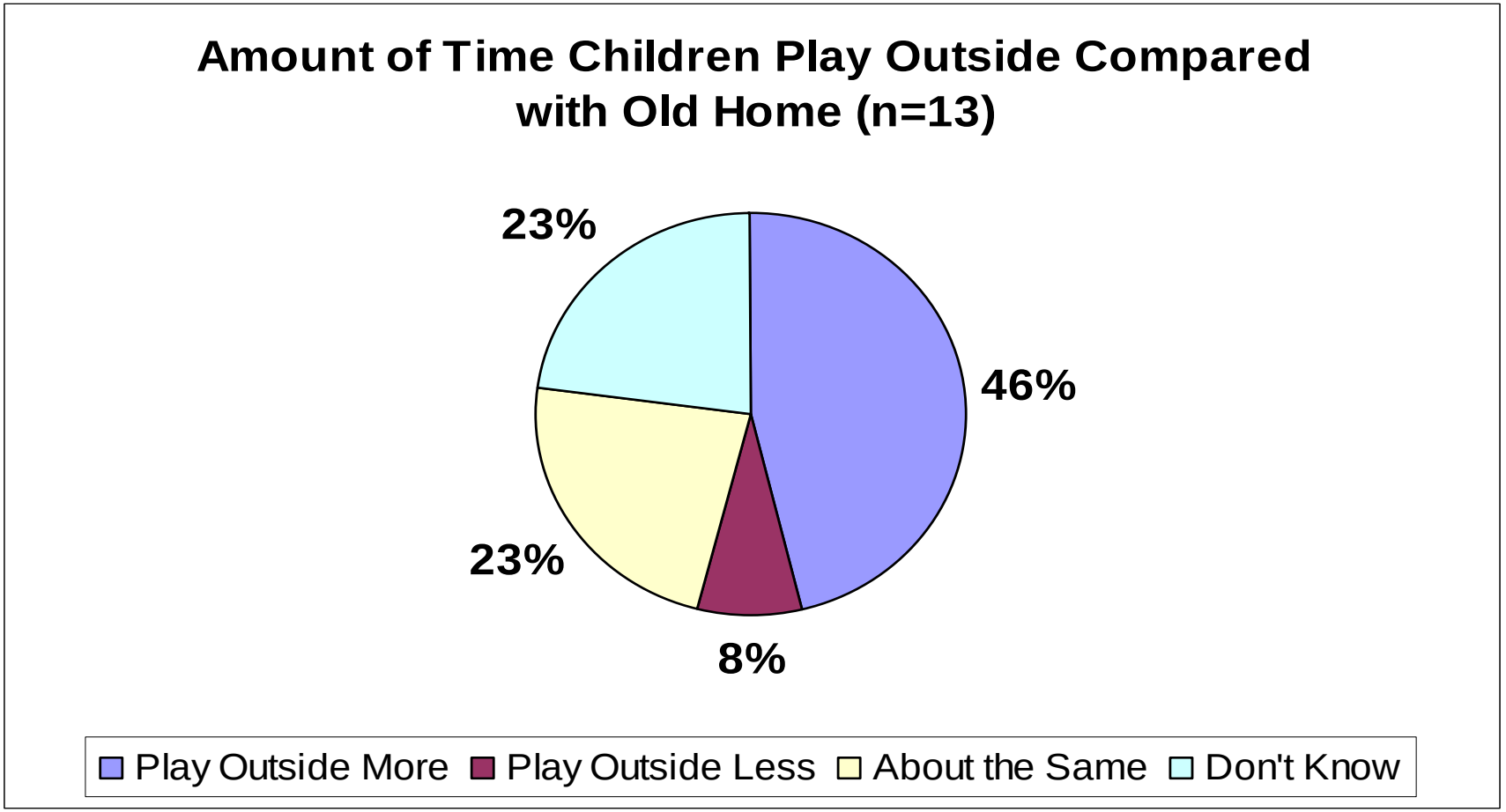
Baseline Questionnaire Results



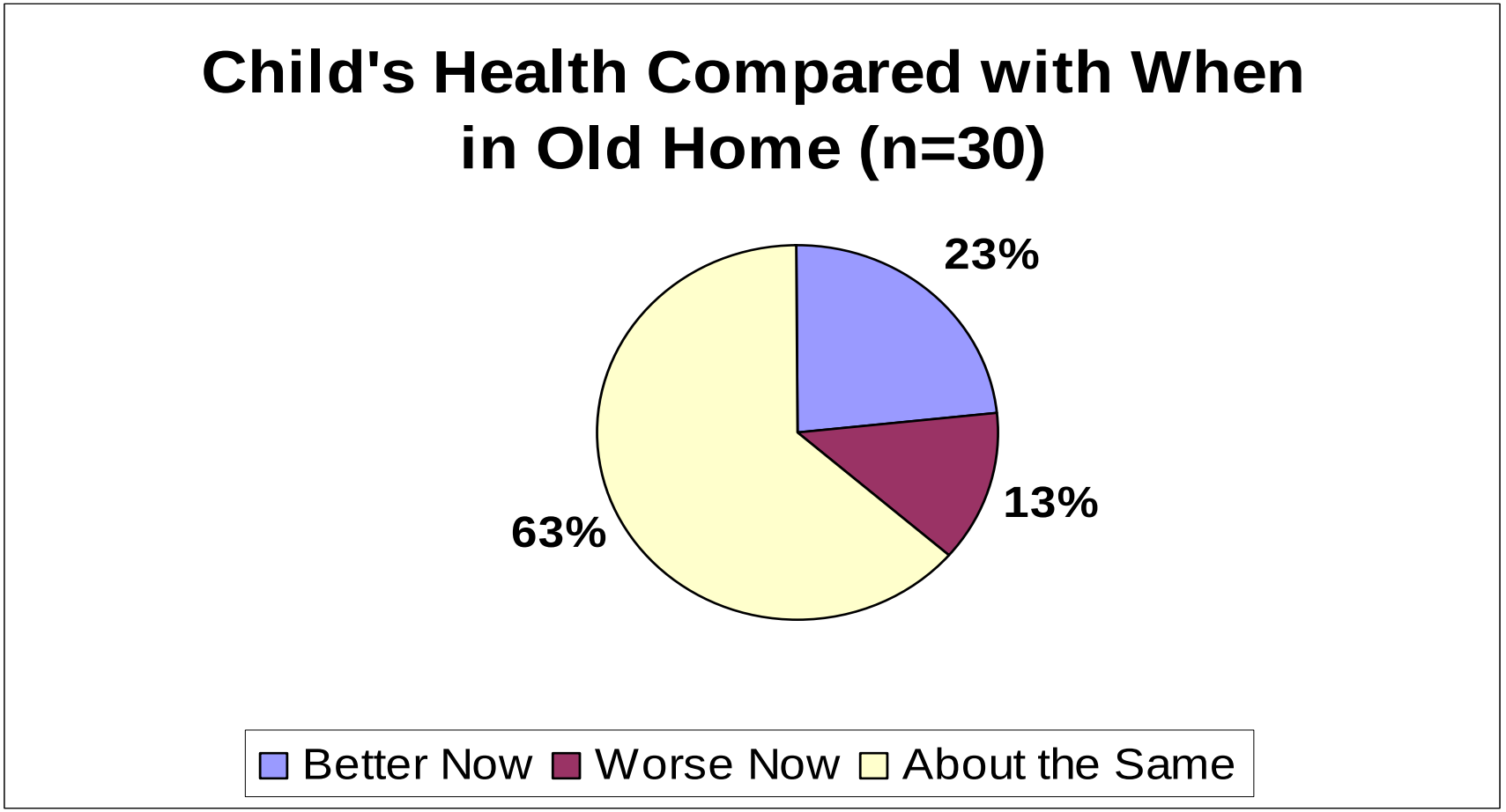
Baseline Questionnaire Results, cont'd



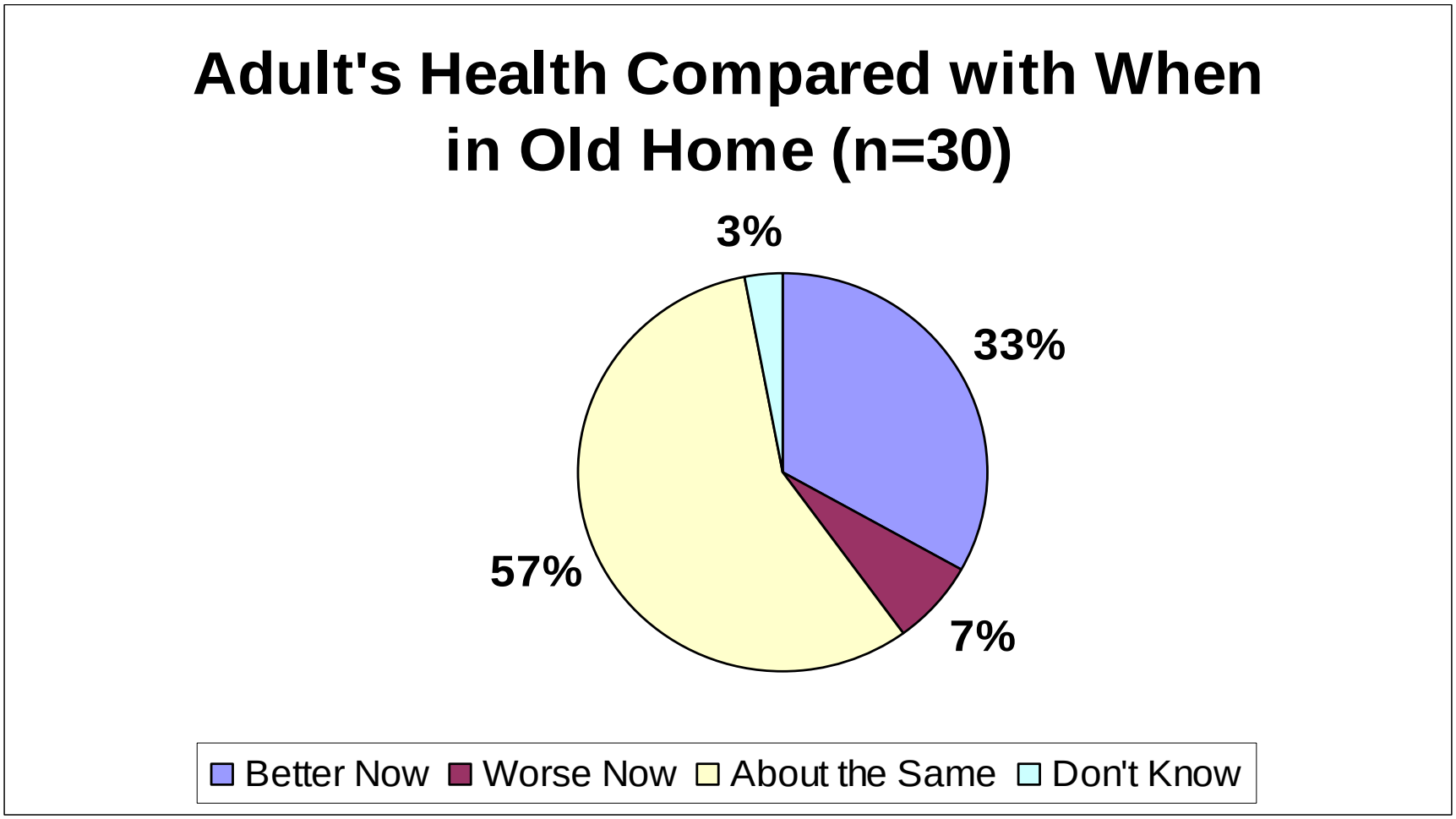
Baseline Questionnaire Results, cont'd



Baseline Questionnaire Results, cont'd



Baseline Questionnaire Results, cont'd



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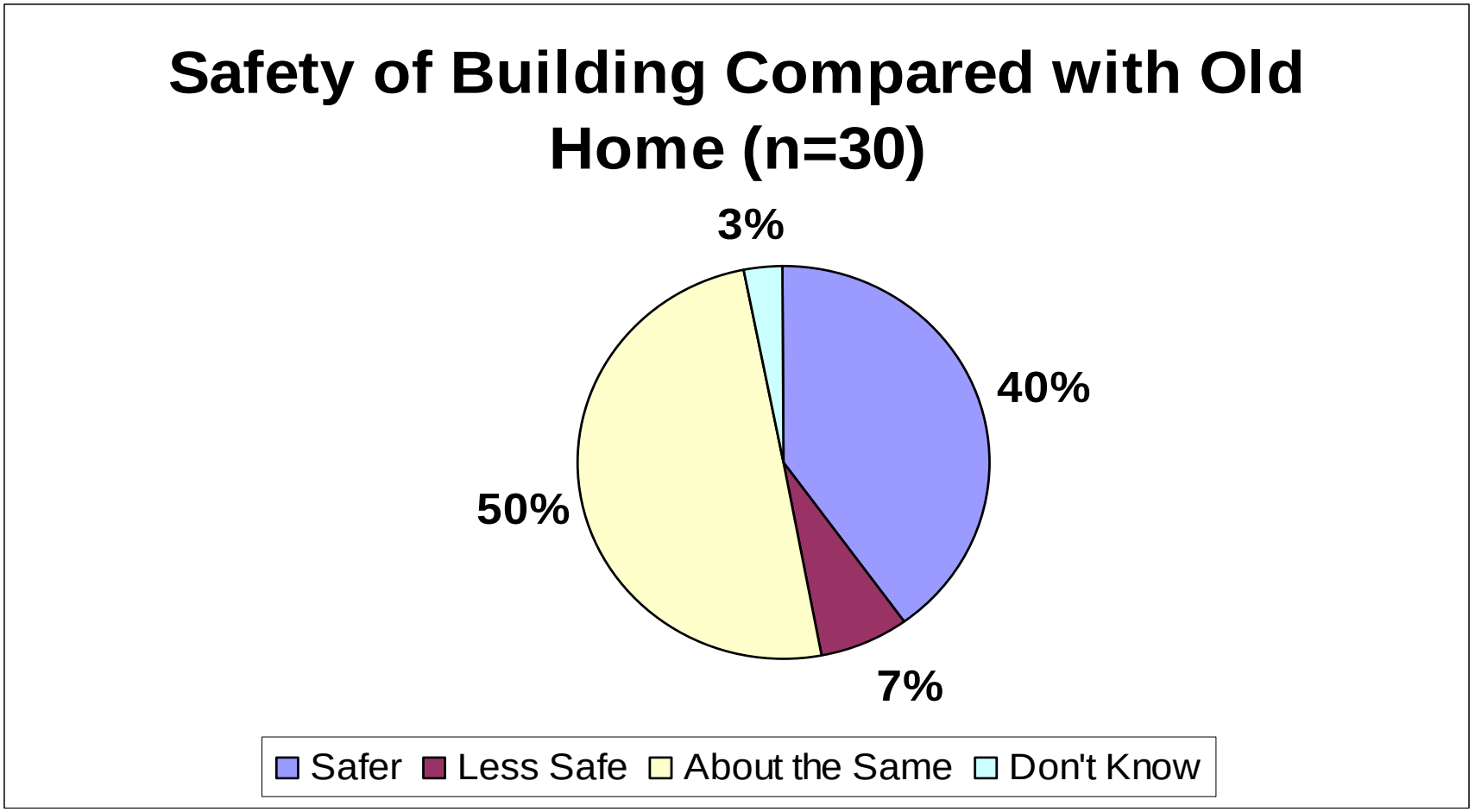


Environmental Testing

- Temperature and Relative Humidity
- Carbon Dioxide Measurements
- Radon: Short-term and long-term
- Total Volatile Organic Compounds (TVOCs)

Radon Testing Results

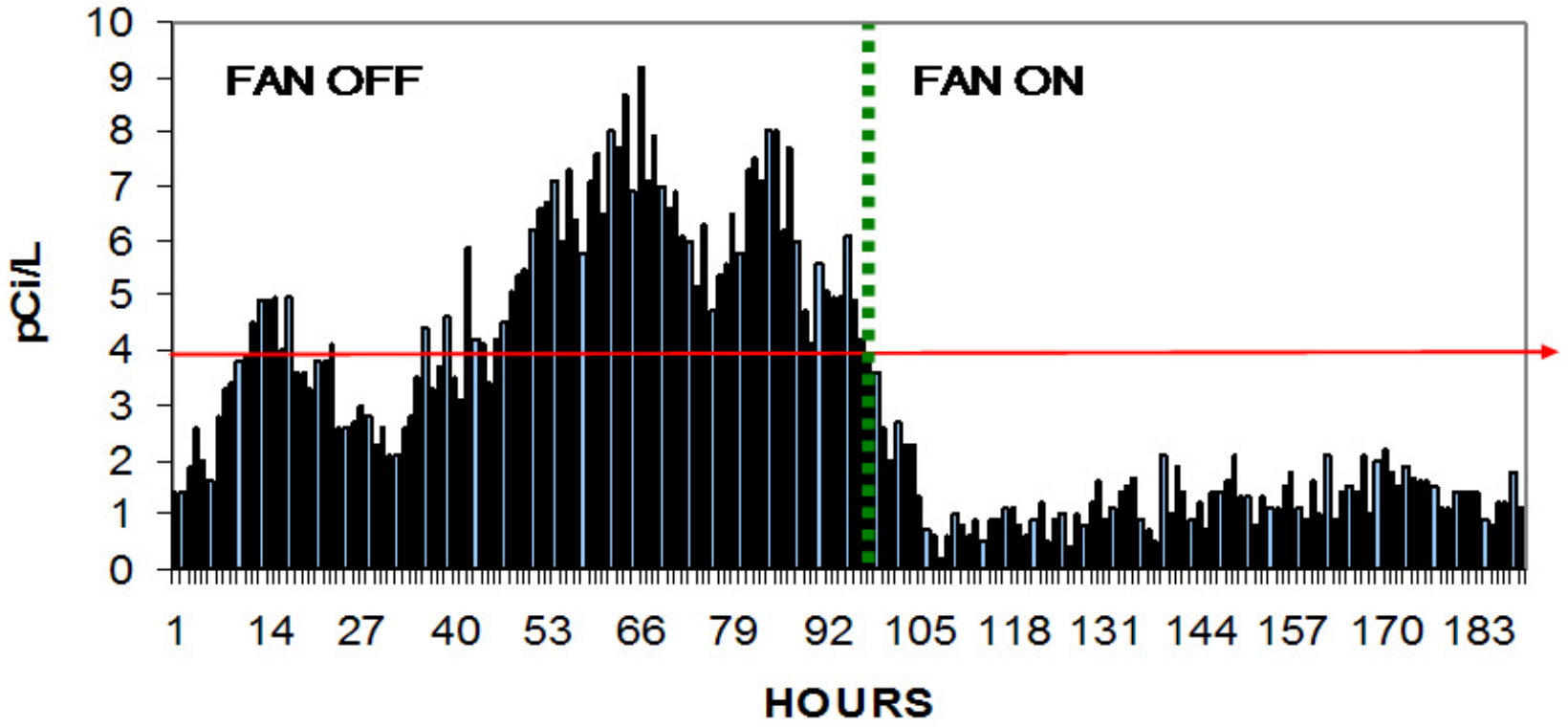
2 Rounds of Pre-Renovation 3-Day Tests:

- Round 1: 29 kits. Range 1.0-6.8 pCi/L; 9 results at or above 4 pCi/L
- Round 2: 8 kits. Range 2.3-4.0 pCi/L; 1 result above 4 pCi/L
- Average: 3.4-5.2 pCi/L; 5 results above 4 pCi/L

Post-Renovation 90-Day Tests:

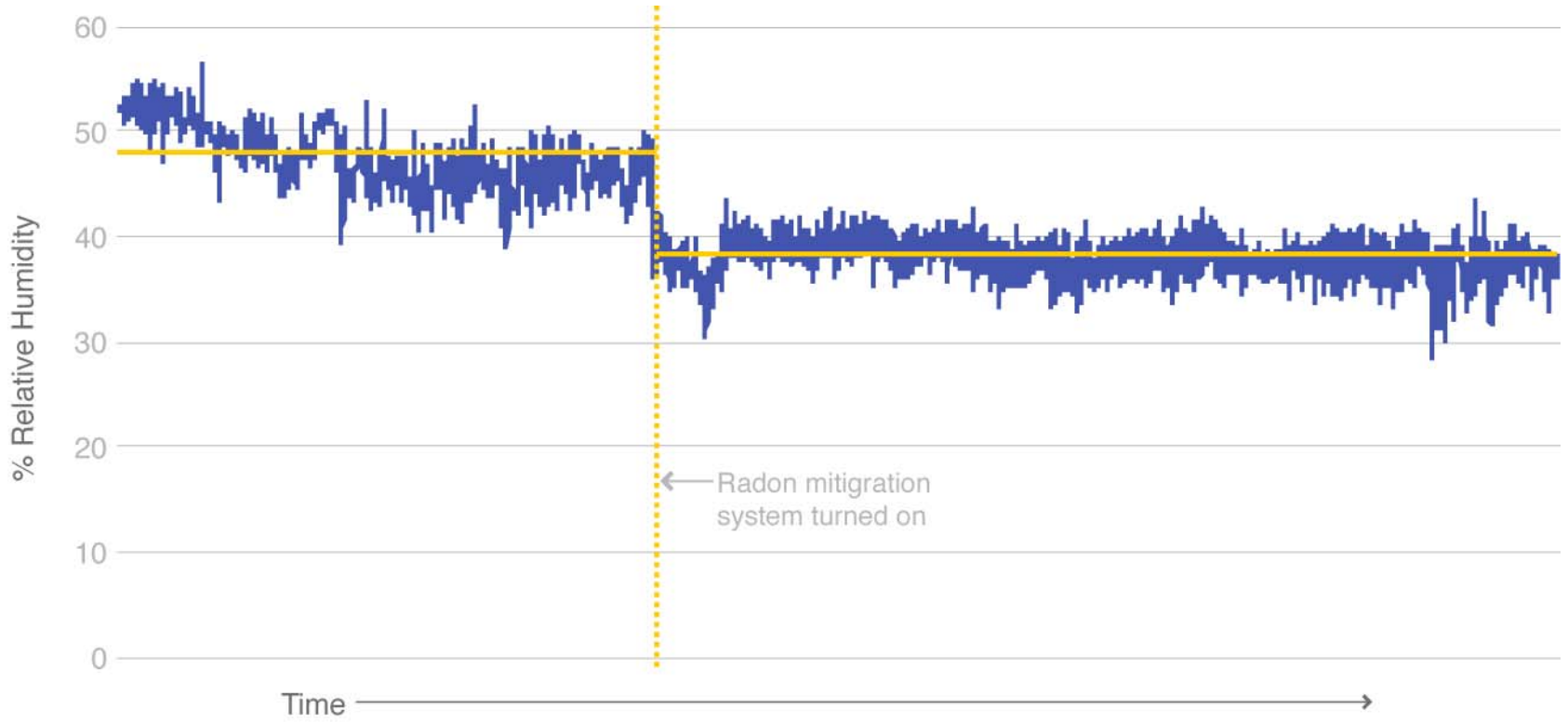
- 22 test kits, 17 recovered. Range 0.6-4.5 pCi/L; 2 results at or above 4 pCi/L

Radon Mitigation



CSBR, 2008

Radon Mitigation Impact on Moisture



CSBR, 2008

Ventilation Testing Results

- Fresh air delivered at about 70% of the ASHRAE standard
- Kitchen and bathroom exhaust air flows slightly below and above specified rates, respectively
- Ductwork required more sealing to reduce leakage.

Summary of Results

- Radon testing indicated need for mitigation, currently ongoing
- Noticeable improvements in child and adult health, comfort, safety and ease of cleaning
- Ventilation measurements show fresh air supply, duct sealing and need for improved exhaust ventilation in kitchens and bathrooms-corrective actions completed

Conclusions to Date

- Low-income housing can be renovated using Green and Healthy Homes principles that promote energy conservation, sustainability and public health and safety.
- Ventilation and environmental testing help ensure that building renovation design performs as intended.
- Collaboration of housing, health and environmental professionals is essential.

Ongoing Work

- Follow-up Health Interview and Visual Assessment
- Additional Ventilation System Performance Testing
- Life Cycle Analysis
- Utility Bill Collection: water and utilities
- Property Manager's Manual
- Training

For More Information:

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