Measuring Food Environments in Communities: Observations and Surveys

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Nutrition environment & measures

NEMS-S and NEMS-R: developing the tools

Dissemination of NEMS & other versions of NEMS

Survey measurement: NEMS-P

Research & practice/policy using NEMS

Future directions
Environments are believed to be important among the multiple levels of determinants of nutrition and physical activity.

Environmental Causes of Obesity & Chronic Diseases

- Increased eating
- Decreased energy expenditure
The Rationale for NEMS (2004)

*Why do a MEASUREMENT study?*

→ In order to do good research, we need reliable and valid measures, yet...

→ In 2004, good measures of nutrition environments did not exist

→ We needed to understand the practical side of measures (time, efficiency)
Model of Community Nutrition Environments

[Glanz, Sallis, Saelens, & Frank 2005]

Policy Variables

Environmental Variables

Individual Variables

Behavior

Community Nutrition Environments
- Type & Location of Food Outlets (stores, restaurants)
- Accessibility – hours of Operation, drive-thru)

Organizational Nutrition Environments
- Home
- School
- Work
- Other

Consumer Nutrition Environment
- Available healthy options
- Price, promotion, placement
- Nutrition Information

Information Environment (Media, Advertising)

Socio-demographics

Psychosocial Factors

Perceived Nutrition Environments

Eating Patterns
Community & Consumer Nutrition Environments

• **Community** nutrition environments =
  – Type & location of food outlets
  – Accessibility (e.g., hours, drive-thru)

• **Consumer** nutrition environments =
  – Availability of healthful food choices
  – Pricing, promotion, placement
  – Information availability
NEMS is/are research-tested measurement tools (first: NEMS-S and NEMS-R)

NEMS...
* was originally developed for research
* can be, and has been, used for community assessment, advocacy, and intervention

http://www.med.upenn.edu/nems/
The objectives of the original Nutrition Environment Measures Study were to:

- Develop measures of nutrition environments and survey retail and food service outlets (stores and restaurants)
- Test the inter-rater and test-retest reliability of NEMS instruments
- Examine sampling and generalizability issues
Phases of the Study

1. Pre-test

Preliminary work:

• develop measures
• test measures
• revise/improve measures for formal research purposes

Where? Atlanta neighborhoods: Decatur (high walk) & Toco Hills (low walk)
Phases of the Study (cont’d)

2. Main measurement study

Collect data to allow us to calculate test-retest reliability & inter-rater reliability in 4 neighborhoods around schools

**Where?** High/low walk & high/low SES neighborhoods, metro Atlanta

- High walk, high SES
- High walk, low SES
- Low walk, high SES
- Low walk, low SES
Key Measurement Characteristics:

Validity

Reliability
Validity

• Whether an instrument measures what it proposes to measure

• Measures reflect true differences in the things they intend to measure
Types of Reliability Examined in NEMS

1. Inter-rater reliability (equivalence)

2. Test-retest reliability (stability)
Reliability in NEMS

1. Inter-rater reliability:

Two raters go to same store/restaurant, same day, same time…

Do they get the same results?
Reliability in NEMS

2. Test-retest reliability:

The same rater goes to the same store/restaurant, one week apart...

Do they get the same results?

This assumes that stores don’t change that fast, but we’re not sure...It depends on measures that aren’t too subject to “random error.”
Test-Retest Reliability and Inter-Rater Reliability

TIME 1

Rater #1

TIME 2 (T1+1 week)

Rater #1

Rater #2

Inter-Rater Reliability

Test-Retest Reliability

Test-Retest Reliability
Measures of Nutrition Environments in Stores (NEMS-S)

< Grocery Stores & Convenience Stores >

• Availability (of healthful choices)
• Prices (compare healthy to less healthy; grocery to convenience stores)
• Quality (for fresh produce)
Measures of Nutrition Environments in Stores
< Grocery Stores & Convenience Stores >

Core Categories of Foods

Milk  Baked Goods  Bread
Fruits  Hot Dogs  Fruit Juice
Vegetables  Frozen Dinners  Chips
Ground Beef  Cereals
Measures of Nutrition Environments in Restaurants (NEMS-R)

< Fast-Food & Sit-Down Restaurants >

• Availability (of healthful choices)
• Prices (compare healthy vs. less healthy; fast-food vs. sit-down)
• Promotion, Information
• Facilitators & Barriers
• Kid’s Menus
Restaurant Measures: **Eat more!**
NEMS Raters in the Field
Findings
• **88 Stores** (90.6% completion rate)
  – 24 grocery stores
  – 64 convenience stores
  – 16-27 stores per neighborhood

• **217 Restaurants**
  • 102 fast food (99% completion rate)
  • 115 sit-down (100% completion rate)
# Inter-Rater Reliability of NEMS Store Observations

<table>
<thead>
<tr>
<th>Variable/Indicator</th>
<th>Inter-Rater Reliability (2 raters, same day)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% agreement</td>
<td>Kappa/V a</td>
</tr>
<tr>
<td>Any fruit – availability</td>
<td>96.47%</td>
<td>.93</td>
</tr>
<tr>
<td>Any vegetables – availability</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Baked chips</td>
<td>96.47%</td>
<td>.92</td>
</tr>
<tr>
<td>Lean ground beef</td>
<td>98.82%</td>
<td>.96</td>
</tr>
<tr>
<td>100% Whole grain bread</td>
<td>92.94%</td>
<td>.83</td>
</tr>
<tr>
<td>Skim/Low-fat milk</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Hot dogs (regular vs. fat-free)</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Reduced- calorie frozen dinner</td>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td>Low-fat baked goods</td>
<td>95.29%</td>
<td>.88</td>
</tr>
</tbody>
</table>

*a Cramer’s V statistic was used when Kappa could not be computed due to asymmetric rater response dimensions*
## Test-Retest Reliability of NEMS Store Observations

<table>
<thead>
<tr>
<th>Variable/Indicator</th>
<th>Test-retest Reliability (1 rater, 2 weeks apart)</th>
<th>% agreement</th>
<th>Kappa/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Fruit – availability</td>
<td></td>
<td>92.68%</td>
<td>.85</td>
</tr>
<tr>
<td>Any Vegetables – availability</td>
<td></td>
<td>96.34%</td>
<td>.91</td>
</tr>
<tr>
<td>Baked chips</td>
<td></td>
<td>95.12%</td>
<td>.89</td>
</tr>
<tr>
<td>Lean ground beef</td>
<td></td>
<td>98.78%</td>
<td>.96</td>
</tr>
<tr>
<td>100% Whole grain bread</td>
<td></td>
<td>90.24%</td>
<td>.75</td>
</tr>
<tr>
<td>Skim/low-fat milk</td>
<td></td>
<td>97.56%</td>
<td>.95</td>
</tr>
<tr>
<td>Hot dogs (regular vs. fat-free)</td>
<td></td>
<td>98.78%</td>
<td>.95</td>
</tr>
<tr>
<td>Reduced calorie frozen dinners</td>
<td></td>
<td>98.78</td>
<td>.96</td>
</tr>
<tr>
<td>Low-fat baked goods</td>
<td></td>
<td>93.90%</td>
<td>.84</td>
</tr>
</tbody>
</table>

*a* Cramer’s V statistic was used when Kappa could not be computed due to asymmetric rater response dimensions.
Grocery Stores vs. Convenience Stores: Availability of Fruit & Vegetables

- **Types of Fruit**
  - Grocery Stores (G.S.): 8
  - Convenience Stores (C.S.): 0
  - Statistical significance: p < .001

- **Types of Vegetables**
  - Grocery Stores (G.S.): 9
  - Convenience Stores (C.S.): 0
  - Statistical significance: p < .001
Grocery Stores vs. Convenience Stores: Availability of Fat-Free Hot Dogs & Baked Chips

- **Fat-Free Hot Dogs**: Grocery Stores (G.S.) have a significantly higher availability compared to Convenience Stores (C.S.). The difference is statistically significant with p < .001.

- **Varieties of Baked Chips**: Grocery Stores also have a higher availability of varieties compared to Convenience Stores. The difference is statistically significant with p < .01.
High- vs. Low-Income Neighborhoods: Availability of Fruits & Vegetables

- **Fruits:**
  - High SES: 5 types
  - Low SES: 2 types

- **Vegetables:**
  - High SES: 5 types
  - Low SES: 2 types

Both comparisons show a significant difference at p < .01.
High- vs. Low-Income Neighborhoods: Availability Fat-Free Hot Dogs & Baked Chips

- Fat free Hot Dogs: n.s., trend p < .01
- Varieties of Baked Chips: p < .01
Shelf Space

Skim Milk vs. Full-Fat Milk

40% of shelf space was occupied by skim milk

This percentage was found to be higher in grocery stores & high SES areas
Cost Comparisons

Fruits (Bananas)

Bananas cost 32% more in convenience stores than in grocery stores.

\[ \frac{0.62}{0.47} = 132\% \quad \text{CS/GS} \quad (p<.001) \]

Milk

The difference in cost of skim milk versus full fat milk was not significant.

\[ 0.99 = \text{ratio skim/full fat milk} \]
Cost Comparisons

Hot Dogs
Lean franks cost 15% more than regular-fat franks

Ground Beef
Lean meat costs 55% more than regular-fat

Chips
Low-fat chips cost 31% more than regular-fat

Juice
100% juice costs 53% more than juice drink
## NEMS Composite Mean Scores for Stores

<table>
<thead>
<tr>
<th></th>
<th>Grocery Stores (n=24)</th>
<th>Convenience Stores (n=61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>17.33</td>
<td>3.54</td>
</tr>
<tr>
<td>Price</td>
<td>0.13</td>
<td>1.54</td>
</tr>
<tr>
<td>Quality</td>
<td>5.13</td>
<td>0.077</td>
</tr>
<tr>
<td><strong>Total</strong>*</td>
<td><strong>22.58</strong></td>
<td><strong>5.85</strong></td>
</tr>
</tbody>
</table>

*Maximum possible total score is 50 points*
### NEMS Composite Mean Scores for Stores By Neighborhood SES

<table>
<thead>
<tr>
<th></th>
<th>High Income (n=44)</th>
<th>Low Income (n=41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>10.23</td>
<td>4.44</td>
</tr>
<tr>
<td>Price</td>
<td>0.30</td>
<td>2.05</td>
</tr>
<tr>
<td>Quality</td>
<td>2.61</td>
<td>1.34</td>
</tr>
<tr>
<td><strong>Total</strong>*</td>
<td><strong>13.14</strong></td>
<td><strong>7.83</strong></td>
</tr>
</tbody>
</table>

*Maximum possible score is 50 points*
Restaurant Findings

Inter-Rater Reliability (% agreement):

Recording sources = 100%
Healthy choices shown = 86%
Total entrees = 78%
# Healthy entrees = 87%
# Nutrition Environment Comparisons by Restaurant Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sit-down (n=115)</th>
<th>Fast Food (n=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy entrée available</td>
<td>20.9%</td>
<td>36.3%</td>
</tr>
<tr>
<td>Proportion of entrees that are healthy</td>
<td>3.2%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Healthy main dish salads available</td>
<td>9.6%</td>
<td>24.5%</td>
</tr>
<tr>
<td>Proportion of healthy main dish salads</td>
<td>11.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Fruit available</td>
<td>11.3%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Non-fried vegetables available</td>
<td>53.0%</td>
<td>26.5%</td>
</tr>
</tbody>
</table>
Time for Completing Measures

Convenience stores
  mean = 14.4 minutes; range = 10-18 min.

Grocery Stores
  mean = 41.8 minutes; range = 30-66 min.

Restaurant site visits
  mean = 11.5 minutes; range = 9-35 min

Menu reviews
  mean = 35 minutes
Dissemination of NEMS Tools & Methods

- Demand started during development
- Initial funding support from RWJF
- 2-3 day trainings & train-the-trainer
- CD-Rom and online tools post-training
- Assumed from the start that many users would customize the tools
- Partnerships to stretch $$$ - state health departments, universities, CDC, etc.
Dissemination of NEMS: In Person Trainings

40 states in the U.S. with over 200 people trained, 3 from Canada, 3 from Singapore, and participants from Netherlands, Japan, and China
NEMS Customization

• The NEMS-S tool was designed to be easily customizable to suit a projects’ needs
• All measures are available in Word or Teleform formats, and now for PDA, and tablets
• We stress the importance of pre-testing new adaptations, and reliability testing
NEMS Online Training

- Includes NEMS-S and NEMS-R modules
- Initially launched in January 2010
- Course is free
- Won a bronze award from the United States Distance Learning Association (USDLA) for 2010 Best Practices in Distance Learning Programming
730 domestic registrants, 46 international (Brazil, Canada, England, France, Iran, Ireland, Jamaica, Jordan, New Zealand, Singapore, Spain...)
### Evaluation Data (n=265)

**Rating Aspects of Online Training on 1-5 Scale**

<table>
<thead>
<tr>
<th>Item</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall training</td>
<td>4.41</td>
</tr>
<tr>
<td>Organization</td>
<td>4.68</td>
</tr>
<tr>
<td>Content</td>
<td>4.50</td>
</tr>
<tr>
<td>Resources &amp; printable items</td>
<td>4.55</td>
</tr>
<tr>
<td>Software works on computer</td>
<td>4.60</td>
</tr>
<tr>
<td>Ease of navigation</td>
<td>4.46</td>
</tr>
<tr>
<td>Registration process</td>
<td>4.49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store simulations (n=264)</td>
<td>4.36</td>
</tr>
<tr>
<td>Restaurant simulations (n=259)</td>
<td>4.30</td>
</tr>
<tr>
<td>Other online activities (n=184)</td>
<td>4.42</td>
</tr>
<tr>
<td>Fieldwork (n=219)</td>
<td>4.35</td>
</tr>
<tr>
<td>Quality of instructor’s responses to questions (n=165)</td>
<td>4.38</td>
</tr>
</tbody>
</table>
Other NEMS Tools

- NEMS-CS - Corner stores
- NEMS-V – vending machines
- NEMS-P – perceived food environments
- NEMS-B (beverages) – NYC 2013
- NEMS-GM – grocery store marketing environment
- Hospital cafeterias & hospital food environments
- University campuses
- National parks by CDC (Data being analyzed)
- NEMS Mexican/Latino version
Measures of Nutrition Environments in Corner Stores (NEMS-CS)

Adapted from the NEMS-S:

**NEMS-S includes** -
- ✓ 11 common food categories
- ✓ Availability of healthful food choices
- ✓ Quality of fresh produce
- ✓ Price of healthy vs. less healthy options

**NEMS-CS added** -
- ✓ Frozen and canned fruits and vegetables
- ✓ Quantities of fresh produce
- ✓ Individual snack items
- ✓ Visibility of intervention promotional materials

Cavanaugh et al., *Prev Med* 2013
NEMS goes Mobile

PDA version of NEMS-CS developed as part of the CPPW Enhanced Evaluation

- Evaluation of Philadelphia Healthy Corner Store Initiative
- Collected NEMS-CS data in low-intervention and high-intervention corner stores (Cavanaugh et al., *Prev Med* 2013)
Nutrition Environment Measures Survey-Vending Machines (NEMS-V)

• Developed to assess the nutrition environment of workplace vending machines
• Based on the Institute of Medicine’s (IOM) nutrition standards for foods in schools
• Intended to be easy to use by having a red, yellow and green coding system.
• Goal is to have machine stocked with more yellows and greens than red so workers have more options to healthier choices

http://www.nems-v.com/
NEMS-V Website Features

- **NEMS-V Tools Tutorial**: 15 minute online demonstration on how to complete a NEMS-V assessment
- **NEMS-V Healthy Choices Calculator Tutorial**: 5 minute online demonstration on how to use the Healthy Choices Calculator to determine green, yellow, or red food/beverage choices
- **Ready to complete graphic** for displaying vend #, color code and/or calories for each machine
- **Printable awards and report cards** for each machine
- **Social marketing messages** that can be printed
- **Developing an iPhone & android application** of healthy choices calculator
• Includes the following dimensions:
  – Beverage availability
  – Serving/bottle size
  – Price
  – Promotional signage for beverages

• Categories of beverages:
  – Sugar sweetened beverages
  – Low/no-calorie beverages
  – 100% fruit juice
  – Milk
  – Bottled water
  – Blended beverages (smoothies, milkshakes, and icees)
  – Coffee/hot beverages
Measures of Perceived Nutrition Environments (NEMS-P)

- Perceptions of the nutrition environment are important to the relationship between nutrition environments and obesity

- Need for a reliable and valid measure to comprehensively assess the perceived food environment and its dimensions
Developing NEMS-P

- Expert review of item inventory
- Cognitive testing (N=15 from 4 neighborhoods)
- Main pilot study: n = 221 participants completed the survey twice
  - 4 neighborhoods: low SES and high SES (2 neighborhoods each)
  - NEMS-S and NEMS-R completed in stores & restaurants in each neighborhood
Measures of Perceived Nutrition Environments (NEMS-P)

- NEMS-P survey includes 117 items covering these constructs:
  - Community Nutrition Environment (8 items)
  - Consumer Nutrition Environment (32 items)
  - Home Food Environment (22 items)
  - Shopping Behavior (11 items)
  - Psychosocial Factors (9 items)
  - Background Characteristics (25 items)
  - Eating Behaviors (10 items)
Key findings: NEMS-P

- Significant differences between neighborhoods (with higher SES reporting higher scores):
  - Healthy food availability in stores
  - Availability of healthy options in restaurants
  - Availability and accessibility of healthy food in the home

Significant associations of perceived → observed food environments, and perceived FE → weight:
- Availability of healthy foods
- Availability of fruits & vegetables
- Availability of healthy foods in stores and BMI (inverse)
NEMS Literature Review:
Peer reviewed articles that use NEMS from 2008-present

- Projected
- Published *as of June 2013; Includes 2 in-press articles
# Tools Used in Publications

<table>
<thead>
<tr>
<th>NEMS tool used</th>
<th>Number of Articles</th>
</tr>
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<tbody>
<tr>
<td>• NEMS-S</td>
<td>34</td>
</tr>
<tr>
<td>• NEMS-R</td>
<td>18</td>
</tr>
<tr>
<td>• NEM-CS (2013)</td>
<td>1</td>
</tr>
<tr>
<td>• NEMS-V (2012)</td>
<td>1</td>
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### Study Types

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Number of Articles</th>
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<tbody>
<tr>
<td>Observational</td>
<td>44</td>
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<tr>
<td>• Cross-sectional</td>
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<tr>
<td>• Pre-test/Post-test, natural experiments (policy change)</td>
<td>7</td>
</tr>
<tr>
<td>• Case-control</td>
<td>4</td>
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<tr>
<td>• Prospective</td>
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<td>Intervention</td>
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<tr>
<td>Non-empirical</td>
<td>3</td>
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<tr>
<td>Total</td>
<td>48</td>
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### Community Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Articles</th>
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<tbody>
<tr>
<td><strong>Location</strong></td>
<td></td>
</tr>
<tr>
<td>• Within U.S.</td>
<td>42</td>
</tr>
<tr>
<td>Baltimore, Philadelphia, Alaskan villages, rural Maine and Georgia, campuses throughout the U.S.</td>
<td></td>
</tr>
<tr>
<td>• Outside U.S.</td>
<td>4</td>
</tr>
<tr>
<td>Canada, Paraguay, Brazil</td>
<td></td>
</tr>
<tr>
<td><strong>Community Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>• Urban</td>
<td>24</td>
</tr>
<tr>
<td>• Suburban</td>
<td>5</td>
</tr>
<tr>
<td>• Rural</td>
<td>10</td>
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</tbody>
</table>
## Population Characteristics

<table>
<thead>
<tr>
<th>Population</th>
<th>Number of Articles</th>
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</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td></td>
</tr>
<tr>
<td>• Low-income</td>
<td>16</td>
</tr>
<tr>
<td>• Middle-Income</td>
<td>9</td>
</tr>
<tr>
<td>• Mixed/Comparative</td>
<td>13</td>
</tr>
<tr>
<td><strong>Minority Population</strong></td>
<td></td>
</tr>
<tr>
<td>• Low-minority</td>
<td>5</td>
</tr>
<tr>
<td>• Medium-minority</td>
<td>5</td>
</tr>
<tr>
<td>• High-minority</td>
<td>17</td>
</tr>
</tbody>
</table>
NEMS Publication Review: Key Findings

NEMS Adaptations

• Successful development, pilot-testing, and implementation of modified NEMS measures to evaluate:
  – College campuses
  – Children’s menus
  – Vending machines
  – Hospital and school cafeterias

Horacek et al., 2012; Horacek et al., 2013; Krukowski, Eddings & Smith West, 2011; Voss, Klein, Glanz & Clawson, 2012; Lesser et al., 2012; Krukowski et al., 2011
Key Findings, cont’d

Healthy foods were found to be:

• More available in higher-income neighborhoods
  (Franco, Diez Roux, Glass, Caballero & Brancati, 2008; Leone et al., 2011)

• More available in black neighborhoods than in white neighborhoods
  (Franco et al., 2008)

• Healthy food scores for stores and restaurants increased as neighborhood education increased
  (Duran, Diez Roux, Latorre & Jaime, 2013)
Key Findings, cont’d

Consumer nutrition environment correlations with health outcomes

- Store availability rankings were a significant indicator of household BMI in a developing urban city in Paraguay (Gartin, 2012).

- Lower availability of healthy food in the closest store or a census tract or was associated with the consumption of a poorer-quality diet in adults (Franco et al., 2009).
Key Findings, cont’d

The effect of policy changes on the availability of healthful foods


- Nutrition-labeling regulations only affected modest, non-uniform improvements (Saelens et al., 2012).
NEMS in Practice and Policy

- **LiveWell EatWell Restaurant Challenge, Lawrence, KS, 2011-present**
  - 56 restaurants evaluated with NEMS-R
  - 17 participating in Restaurant Challenge to offer healthy options

- **Arizona Area Health Education Center**
  - NEMS-S and NEMS-R to assess the community nutrition environment
  - Establishing baseline measures
  - Identifying policy or environmental interventions
NEMS in Practice

• Adaptation of NEMS for use in Guatemala
  – Development of a modified NEMS-S to assess the food environment in a country undergoing a nutrition transition

• Smart phone app using NEMS-R scores, Cerro Gordo County, IA, 2013
  – Development of a Strategy Guide for Improvement for restaurant managers
  – Developing a smart phone app for public use
NEMS in Practice

• Hospital Food/Beverage Scans
  – Adaptation of NEMS-R, NEMS-S, NEMS-V by researchers at the CDC to assess the nutrition environment in hospitals nationwide

• The Restaurant Project, Chenango County, NY, 2011
  – Working with restaurants to promote healthy food choices and promoting the restaurants locally

• Hearts Beat Back: The Heart of New Ulm Project, New Ulm, MN, 2011
  – Created a report of restaurants using NEMS
  – Working with restaurants to modify menus
Limitations of NEMS measures

No one environment covers a population or person’s complete food access

May have left out some important variables
What We DO and DO NOT Know

• Distribution of unhealthy environments (SES, etc.) $\Rightarrow$ *we know A LOT*

• Environmental vs. individual/social determinants? $\Rightarrow$ *we know A BIT*

• How much environmental change is needed? $\Rightarrow$ *we know VERY LITTLE*
Keeping Up with NEMS News

NUTRITION ENVIRONMENT MEASURES SURVEY

NEMS News

We would like to share with others all of the exciting news and activities that relates to NEMS, whether it is a project update, a publication, grant funding, customizations, etc. Please send us an email at nems@zimbra.upenn.edu. Please click on the different categories below to learn more.

News from Us  News from You  Webinars  Publications  Project Updates
Let’s build a better mousetrap...
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