INTEGRATING HEALTH INTO SCENARIO PLANNING

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Mission
To Support clients with innovative and objective information and tools to realize environmental, economic, and quality of life goals that are intrinsic in efforts to build new and to retrofit existing communities”.

“Pracademic” approach
Applied policy research, evidence based advice on relative impacts of alternative approaches to land use and transportation investment decisions.

Specialization
Interactions between land use, transportation, air quality, and public health.

Reputation
Demonstrated track record in conducting scholarly research and has been a leader in the assessment of how the design of communities impacts environmental and health related outcomes.
UrbanFootprint Health Module – background, theory
UrbanFootprint Health Module

• Growing body of evidence that the built environment influences travel, physical activity and health

• Health-related outcomes and costs need to be considered when making transportation & land use decisions

• Integrating health metrics into scenario planning results in a quantitative Health Impact Assessment tool
Quality of Life

Environmental Quality
Air Quality and Greenspace

Human Behavior
Travel Patterns and Physical Activity

Built Environment
Transportation Investments and Land Use
CONCEPTUAL MODEL

Land Use Patterns

Travel Choice Physical Activity & Dietary Patterns

Body Mass Index

Chronic Disease Onset

Health Care Utilization Patterns & Health Care Costs

Path I - Behavioral

Travel Patterns

Vehicle Emissions

Respiratory Function

Path II - Exposure

Built Environment

Transportation Investments

Note: Diet and nutrition, age, gender, income, genetics, and other factors also impact weight and chronic disease and to the extent possible are controlled in analyses. Vehicle age and climate impacts emissions and air quality, and respiratory function is also impacted by a variety of factors.
Builds on previous efforts:

• INDEX (Criterion Planners): Livable Community Initiative: Atlanta (SMARTRAQ)
• I-PLACE3S (California Energy Commission): King County, added health module
• Community Viz (Placeways): San Diego, Toronto, Ontario & Surrey, BC - added health module
• UrbanFootprint (Calthorpe Associates):
  – Vision California - added basic health module
  – Current update – refining models with better local data
Tool Development

Data Needs - identify and acquire
- Outcomes
- Demographics
- Parcels, land use
- Transportation system

Built environment measures - create
- Review, clean, organize data
- Create measures, and map results
- Check variation across region
- Investigate extreme values

Analysis
- Determine association of outcomes with built environment & demographics
- Create elasticities, which describe the magnitude and direction of change outcomes

Tool Development
- Develop tool
- Add elasticities
- Develop user interface

Application
- Select test areas
- Gather/enter input data (demographics & built environment)
- Review and compare outcomes across scenarios
- Modify tool as needed
Calculated Outcome Changes

<table>
<thead>
<tr>
<th>Neighbourhood Design Feature</th>
<th>Health Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>value X</td>
</tr>
<tr>
<td>Scenario A</td>
<td>value Y</td>
</tr>
<tr>
<td>Scenario B</td>
<td>value Z</td>
</tr>
</tbody>
</table>
UrbanFootprint Health Module – overview
Study Region

30 counties across five California regions:

- San Francisco Bay Area
- Sacramento
- San Diego County
- San Joaquin Valley
- Southern California (including Los Angeles)
California Data sources

Provide Calif. demographics, socioeconomic status, behaviors, and health conditions:

- **UrbanFootprint (UF)** built environment, demographic, and socioeconomic data
- **Calif. Health Interview Survey (CHIS)**
- **Calif. Household Transport. Survey (CHTS)**
Strengths of approach

• **Large sample sizes**
  – 53,733 CHTS participants
  – 40,617 CHIS participants

• **Strata-specific model development**
  – 4 age groups (seniors, adults, teens, children)
  – For adults, three HH income groups (<$50k, $50-100k, >$100k)

• **California-specific evidence base**
  – CHIS and CHTS data were collected from a representative cross-section of Californians

• **Variability in built environment characteristics**
  – 30-county study area covers a broad range of built environments and travel behaviors across California
Model overview

• Model calibration
  – California-specific data used to estimate associations between built environment characteristics & health behaviors/outcomes

• User inputs
  – Land use, transportation system, population characteristics

• Calculated outputs
  – Estimates of physical activity, obesity, and related health outcomes

• Reporting of results
  – Models applied at scale similar to a city block, then aggregated up to more statistically valid units (e.g. Census Tracts)
  – Results summarized in tables and displayed spatially
# Models fitted

<table>
<thead>
<tr>
<th>Data set</th>
<th>Age cohort</th>
<th>Outcome</th>
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<tbody>
<tr>
<td></td>
<td>Adults, by income:</td>
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<tr>
<td></td>
<td>Low</td>
<td>Med</td>
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<td>CHIS</td>
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<td>CHTS</td>
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</tbody>
</table>
Sample sizes by cohort

- **CHIS:**

<table>
<thead>
<tr>
<th>Age groups</th>
<th>All</th>
<th>Low (&lt;$35k)</th>
<th>Med ($35-100k)</th>
<th>High (&gt;$$100k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (5-11)</td>
<td>3,117</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Teens (12-17)</td>
<td>2,367</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (18-64)</td>
<td>23,515</td>
<td>9,188</td>
<td>6,537</td>
<td>7,790</td>
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<tr>
<td>Seniors (65+)</td>
<td>11,618</td>
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</tbody>
</table>

- **CHTS:**

<table>
<thead>
<tr>
<th>Age groups</th>
<th>All</th>
<th>Low (&lt;$50k)</th>
<th>Med ($50-100k)</th>
<th>High (&gt;$$100k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (5-11)</td>
<td>4,829</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teens (12-17)</td>
<td>4,734</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (18-64)</td>
<td>35,695</td>
<td>10,593</td>
<td>11,283</td>
<td>13,819</td>
</tr>
<tr>
<td>Seniors (65+)</td>
<td>8,475</td>
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</tbody>
</table>
Built environment data development

• Built environment variables were aggregated from grid cells to 1km airline buffers of each grid cell

• UF grid cells are 150m x 150m (about 5.5 acres)
Model Variables - Built Environment

- **Walkability index**
  - dwelling unit count w/n 1km
  - residential density w/n 1km
  - retail floor area w/n 1km
  - non-residential FAR w/n 1km
  - distance to nearest retail
  - distance to nearest restaurant
  - land use mix w/n 1km
  - intersection density w/n 1km
  - local street length w/n 1km

- **Major road index**
  - major street length w/n 1km
  - any major road within 500m

- **Regional accessibility index**
  - regional residential accessibility
  - regional employment accessibility

- **Transit access index**
  - transit stop count w/n 1km
  - distance to nearest transit stop

- **Rail transit access within 2km**
  - Park acres w/n 1km
  - Distance to nearest park

- **Distance to nearest school**
  - Park acres w/n 1km
  - Distance to nearest park
Model fitting procedure

• Applied variety of regression types:
  – Linear regression
  – Binary logistic regression
  – Poisson regression
  – Two-part regression for zero-inflated outcomes
    • Binary logistic regression for likelihood of any activity
    • Linear regression for amount of activity for those with any

• Backward stepwise variable selection process

• Validation process to check for:
  – Multicollinearity problems
  – Consistency of associations and predicted results with published evidence
### CHIS Adult Models

Comparing 1) observed outcomes, 2) base year forecasted outcomes, 3) forecasted outcomes after built environment improvements

<table>
<thead>
<tr>
<th>Outcome</th>
<th>mean sample observed outcome</th>
<th>mean base predicted outcome</th>
<th>mean change predicted outcome</th>
<th>absolute change (base predicted – change predicted)</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>minutes of transportation walking (daily)</td>
<td>5.0</td>
<td>5.0</td>
<td>6.0</td>
<td>1.0</td>
<td>19.1%</td>
</tr>
<tr>
<td>minutes of transportation biking (daily)</td>
<td>1.2</td>
<td>1.1</td>
<td>1.3</td>
<td>0.2</td>
<td>17.8%</td>
</tr>
<tr>
<td>minutes of automobile transportation (daily)</td>
<td>74.9</td>
<td>75.2</td>
<td>74.3</td>
<td>-0.9</td>
<td>-1.2%</td>
</tr>
<tr>
<td>minutes of recreational PA (daily)</td>
<td>17.9</td>
<td>17.9</td>
<td>18.4</td>
<td>0.5</td>
<td>2.7%</td>
</tr>
<tr>
<td>body mass index</td>
<td>26.9</td>
<td>26.8</td>
<td>26.7</td>
<td>-0.2</td>
<td>-0.7%</td>
</tr>
<tr>
<td>likelihood of being overweight or obese</td>
<td>56.4%</td>
<td>56.4%</td>
<td>54.7%</td>
<td>-1.7%</td>
<td>-3.0%</td>
</tr>
<tr>
<td>likelihood of being obese</td>
<td>23.4%</td>
<td>23.3%</td>
<td>22.3%</td>
<td>-1.0%</td>
<td>-4.3%</td>
</tr>
<tr>
<td>likelihood of having high blood pressure</td>
<td>25.8%</td>
<td>25.7%</td>
<td>24.9%</td>
<td>-0.8%</td>
<td>-3.0%</td>
</tr>
<tr>
<td>likelihood of having heart disease</td>
<td>4.8%</td>
<td>4.7%</td>
<td>4.6%</td>
<td>-0.1%</td>
<td>-2.1%</td>
</tr>
<tr>
<td>likelihood of having type 2 diabetes</td>
<td>6.1%</td>
<td>5.9%</td>
<td>5.6%</td>
<td>-0.3%</td>
<td>-5.0%</td>
</tr>
<tr>
<td>likelihood of having poor self-reported health</td>
<td>17.8%</td>
<td>17.6%</td>
<td>17.5%</td>
<td>-0.2%</td>
<td>-0.9%</td>
</tr>
</tbody>
</table>

Results are preliminary and for illustrative purposes only
Potential applications

• Better inform decisions related to:
  – Development proposals
  – Land use and transportation plans/policies
  – Capital investments
• Conducting Health Impact Assessments
• Monetizing health-related impacts
• Identifying and mitigating health disparities at a high spatial resolution
Examples of health model applications
CommunityViz - “painting” new land uses
CommunityViz - charts & indicators
# Health metrics: Palomar Gateway case study (San Diego)

The table below shows the health metrics for the Palomar Gateway case study in San Diego. The data includes changes in various health indicators such as daily minutes in car, daily minutes transportation walking, daily minutes leisure walking, percent visiting park in last 30 days, Body Mass Index, percent of adults obese, percent of adults overweight or obese, percent of adults with high blood pressure, percent of adults with Type 2 Diabetes, and percent of adults 18 and up with current asthma. The change is indicated by percent, with color key showing 1-10% change - positive health impact, 10-25% change - positive health impact, over 25% change - positive health impact, 1-10% change - negative health impact, 10-25% change - negative health impact, over 25% change - negative health impact.

<table>
<thead>
<tr>
<th>HEALTH INDICATOR</th>
<th>Regional base</th>
<th>Base Scenario</th>
<th>Change Scenario</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily minutes in car – adults (age 16 and up)</td>
<td>55.81</td>
<td>49.04</td>
<td>44.89</td>
<td>-8.46%</td>
</tr>
<tr>
<td>Daily minutes transportation walking – adults (age 16 and up)</td>
<td>6.61</td>
<td>6.1</td>
<td>10.24</td>
<td>67.87%</td>
</tr>
<tr>
<td>Daily minutes leisure walking - adults (18 and up)</td>
<td>12.27</td>
<td>8.42</td>
<td>8.87</td>
<td>5.34%</td>
</tr>
<tr>
<td>Daily minutes leisure moderate activity (adults 18+; not incl. walking)</td>
<td>34.21</td>
<td>17.33</td>
<td>18.38</td>
<td>6.06%</td>
</tr>
<tr>
<td>Percent visiting leisure moderate activity (adults 18 and up)</td>
<td>70.3</td>
<td>56.95</td>
<td>59.23</td>
<td>4.00%</td>
</tr>
<tr>
<td>Body Mass Index - Adults 18 and up</td>
<td>26.73</td>
<td>28</td>
<td>27.65</td>
<td>-1.25%</td>
</tr>
<tr>
<td>Percent of adults obese</td>
<td>21.7</td>
<td>32.73</td>
<td>31.66</td>
<td>-3.27%</td>
</tr>
<tr>
<td>Percent of adults overweight or obese</td>
<td>59</td>
<td>68.91</td>
<td>66.98</td>
<td>-2.80%</td>
</tr>
<tr>
<td>Percent of adults with high blood pressure</td>
<td>28.2</td>
<td>30.92</td>
<td>26.16</td>
<td>-15.39%</td>
</tr>
<tr>
<td>Percent of adults with Type 2 Diabetes</td>
<td>4.4</td>
<td>8.63</td>
<td>7.8</td>
<td>-9.62%</td>
</tr>
<tr>
<td>Percent of adults 18 and up with current asthma</td>
<td>10.8</td>
<td>5.69</td>
<td>5.43</td>
<td>-4.57%</td>
</tr>
</tbody>
</table>
Predicted daily min. physical activity (blue = high, red = low) – San Diego
Predicted active trips/person/day - Toronto

Map showing the predicted active trips/person/day by 1km buffered postal code in Toronto. The map uses various colors to indicate different levels of predicted trips, including low, medium-low, medium-high, and high, with public green areas, highways, and major roads also marked on the map. The data sources, projection details, and credit information are provided in the legend.