Transportation + Health
How Transportation Infrastructure Impacts Health

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Quality of Transportation Infrastructure

Mode Choice

Wasted Time
Wasted Fuel
Access to Healthcare
Physical Activity*
Air Pollution*

"Eyes on the street"

Crashes
Noise
Carbon Emissions

Various Disseminated Health Effects

Respiratory Conditions
Cardiovascular Disease
Cancer
Obesity
Social Cohesion
Crime
Mortality
Injury
Mental Health
Global Environmental and Human Health

All outcomes are interrelated

Adapted from Cole et al. 2008
Public Transit is a Health Resource

- Free Time ➡
- Physical Activity ➡
- Access to Health Care ➡
- Disposable Income ➡
- Air Pollution ➡
- Accidents ➡
- Noise ➡
Examples of Health Costs Attributed to Changes in Public Transit Funding and Service

<table>
<thead>
<tr>
<th>Annual Impact</th>
<th>Scenario Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of additional time in traffic</td>
<td>$137.5 million</td>
</tr>
<tr>
<td>Cost of additional fuel burned</td>
<td>$22.7 million</td>
</tr>
<tr>
<td>Cost of additional car crashes, including crashes with bicycles and pedestrians</td>
<td>$33.6 million</td>
</tr>
<tr>
<td>Cost of additional mortality and hospitalizations for asthma, chronic lung disease, heart attacks, heart disease, and major cardiovascular events due to air pollution</td>
<td>$1.5 million</td>
</tr>
<tr>
<td>Cost of lives lost due to decreased physical activity</td>
<td>$74.9 million</td>
</tr>
<tr>
<td>Cost of carbon emissions</td>
<td>$1.9 million</td>
</tr>
<tr>
<td><strong>Total annual cost</strong></td>
<td><strong>$272.1 million</strong></td>
</tr>
</tbody>
</table>
Methodology: Numbers Shifting from Transit to Cars

- In order to estimate the number of individuals switching from transit to driving:
  - Difference between the number of daily transit trips that currently take place and those that would occur under a modeled transportation scenario.

- We assumed, in consultation with CTPS, that each weekday transit rider completes two trips per day (i.e., to and from work) and that 95% of individuals shifting from transit would instead drive under the proposed scenarios.
### Time Spent in Traffic: New drivers will slow traffic for everyone

<table>
<thead>
<tr>
<th>SCENARIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>People who Shift from Transit to Driving per Year</td>
</tr>
<tr>
<td>Additional Time Driving per Year</td>
</tr>
<tr>
<td>Annual Cost of Wasted Time</td>
</tr>
</tbody>
</table>

More time in traffic creates stress and leaves less time for healthy activities, such as exercising or cooking.
Methodology: Air Pollution

- More car exhaust produces air pollution, leading to increases in asthma, chronic lung disease, heart attacks, heart disease, and major cardiovascular events.

- CTPS modeled emissions using EPA’s MOBILE 6.2 software, which takes VMT and travel speeds to estimate air pollution emissions.

- Models gave emissions estimates for Particulate Matter smaller than 2.5 microns in aerodynamic diameter (PM$_{2.5}$) and NO$_x$.

- We then used an EPA Source-Receptor Matrix to convert emissions data into concentrations of air pollution at the county level.
Methodology: Air Pollution

- Population data by county were taken from the US Census.

- Hospitalization rates for asthma, cardiovascular disease, myocardial infarction, COPD, and ischemic heart disease were taken from Massachusetts Community Health Information Profile (MassCHIP) while mortality rates came from the CDC Wonder Database.

- Concentration-Response Function for PM$_{2.5}$ and NO$_x$ were taken from EPA’s Environmental Benefits Mapping and Analysis Program (BenMAP).
Methodology: Air Pollution

- The value of statistical life (VSL) of $8.32 million in 2012 USD was used to monetize mortality endpoints

- BenMAP includes costs for hospitalizations, which includes
  - the cost of illness to society, which includes the total medical costs plus the value of the lost productivity
  - the willingness to pay of the individual, as well as that of others, to avoid the pain and suffering resulting from the illness
Air Pollution: More cars mean less healthy air

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths Caused by Worse Air Quality per Year</td>
<td>0.18</td>
</tr>
<tr>
<td>Hospitalizations Caused by Worse Air Quality per Year</td>
<td>0.17</td>
</tr>
<tr>
<td>Annual Cost of Exposure to Additional Air Pollution</td>
<td>$1.5 million</td>
</tr>
</tbody>
</table>

More car exhaust produces air pollution, leading to increases in asthma, chronic lung disease, heart attacks, heart disease, and major cardiovascular events. “Near roadway” pollution will have additional impacts not quantified here.
Methodology: Physical Activity and Obesity

- Regular physical activity not only prevents obesity, it helps control blood pressure and blood sugar, increases strength and flexibility, and is good for mental health

- Use estimate of how many people would switch from transit to driving from CTPS data

- US DOT and FHWA National Household Travel Survey data indicates that transit users partake in 8.3 additional minutes of daily walking per day

- This amount of daily walking can prevent 0.25% of the population from becoming obese
Methodology: Physical Activity and Mortality

- Health Economic Assessment Tool (HEAT) from the World Health Organization (WHO)
  - Developed by WHO with the guidance of an advisory group of international experts in health, epidemiology, health economics, transport economics, practice/advocacy, and policy development and implementation
  - Based on systematic reviews of the epidemiologic literature, this tool allows one to estimate changes in mortality based on population-level changes in physical activity
  - We used our CTPS-based estimate on those that would shift to driving and simulated an intervention using the HEAT Tool where 30,000 people would walk 8 minutes less 5 days a week
### Physical Activity: Taking transit gets you up and walking

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost Physical Activity</td>
<td>250,000 minutes per day</td>
</tr>
<tr>
<td>Lost Caloric Expenditure</td>
<td>8.2 million per day</td>
</tr>
<tr>
<td>Additional Cases of Obesity Caused by Sedentary Behavior per Year</td>
<td>70</td>
</tr>
<tr>
<td>Additional Deaths Caused by Sedentary Behavior per Year</td>
<td>9</td>
</tr>
<tr>
<td>Annual Cost of Lost Physical Activity</td>
<td>$75 million</td>
</tr>
</tbody>
</table>

Regular physical activity not only prevents obesity, it helps control blood pressure and blood sugar, increases strength and flexibility, and is good for mental health.
Health-Related Outcomes Associated with Speed Limits

- Collisions, Injuries, and Fatalities
- Cost of Crashes
- Pedestrian and Bicyclist Perceptions of Access and Safety
- Parental Safety Perceptions and Children’s Levels of Physical Activity
- Residential Property Values
- Time Spent and Fuel Burned in Traffic
- Air Pollution
Assessment Methods

- Input for much of the quantitative estimates:
  - A 5 mph decrease in the speed limit would translate to a 1.8 mph decrease in average traffic speeds under free flow*
  - Based on a meta-analysis examining many traffic studies, which found a non-linear relationship between the effect of speed limits on actual speeds

Collisions, Injuries, and Fatalities

- Used GIS to link 2006-2009 RMV data on crashes to local roads
- Used the Power Model from Elvik 2009*, a method from a meta-analysis of 115 traffic studies, to estimate the impact of reducing traffic speeds on local roads by 1.8 mph on safety outcomes

Collisions, Injuries, and Fatalities

<table>
<thead>
<tr>
<th>Estimated Annual Decrease based on a 1.8 MPH speed reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crashes</td>
</tr>
<tr>
<td>Fatal Crashes</td>
</tr>
<tr>
<td>Injury Crashes</td>
</tr>
<tr>
<td>Fatalities</td>
</tr>
<tr>
<td>Injured Road Users</td>
</tr>
<tr>
<td>Pedestrian Fatalities</td>
</tr>
<tr>
<td>Cyclist Fatalities</td>
</tr>
<tr>
<td>Injured Pedestrians</td>
</tr>
<tr>
<td>Injured Cyclists</td>
</tr>
</tbody>
</table>

Note: These numbers should not be summed across types of crashes/health outcomes. Some categories are subsets of other categories.

Modeling results predict that the reducing speed limits 5 mph would decrease fatalities and injuries by lessening the risk and severity of motor vehicle collisions.
We used the CDC Web-based Injury Statistics Query and Reporting System (WISQARS) Cost of Injury Reports application to analyze the cost savings that would result from the collision reductions reported above.

## Costs of Crashes

<table>
<thead>
<tr>
<th></th>
<th>Fatalities</th>
<th>Pedestrian Fatalities</th>
<th>Cyclist Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Decrease in Deaths</strong></td>
<td>18</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Medical Cost Avoided</strong></td>
<td>$346,721</td>
<td>$76,699</td>
<td>$18,912</td>
</tr>
<tr>
<td><strong>Work Loss Cost Avoided</strong></td>
<td>$29,347,334</td>
<td>$6,521,513</td>
<td>$1,630,641</td>
</tr>
<tr>
<td><strong>Combined Cost Savings</strong></td>
<td>$29,694,055</td>
<td>$6,598,212</td>
<td>$1,649,553</td>
</tr>
</tbody>
</table>
## Costs of Crashes

<table>
<thead>
<tr>
<th></th>
<th>Injured Road Users</th>
<th>Injured Pedestrians</th>
<th>Injured Cyclists</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Decrease in Number Hospitalized</strong></td>
<td>1,239</td>
<td>50</td>
<td>33</td>
</tr>
<tr>
<td><strong>Medical Cost Avoided</strong></td>
<td>$63,872,373</td>
<td>$2,703,376</td>
<td>$1,652,705</td>
</tr>
<tr>
<td><strong>Work Loss Cost Avoided</strong></td>
<td>$116,610,789</td>
<td>$5,164,047</td>
<td>$3,766,654</td>
</tr>
<tr>
<td><strong>Combined Cost Savings</strong></td>
<td>$180,483,163</td>
<td>$7,867,423</td>
<td>$5,419,359</td>
</tr>
</tbody>
</table>

Decreases in fatalities and injuries would mean financial savings: up to $30 million for fatalities prevented and $180 million for injuries prevented in costs to society due to medical payments and missed work.
Examples of Transportation + Health Tools

- **HEAT**, Health Economic Assessment Tool from the World Health Organization (WHO)
- **PEQI**, Pedestrian Environmental Quality Index
- The “**Power Model**” for collisions
- **WISQARS**, Web-based Injury Statistics Query and reporting system for costs of collisions
A Reminder of our Next Topics

- Visualizing healthy communities
- Ranking health impacts: relative importance and why it matters
- Health data: where to find it and why it matters
- A discussion of tools (e.g. HIA, healthy zoning reviews)
- Finding funding
Prioritized Call Outcomes

- Increasing capacity to leverage existing resources
- Becoming more efficient via incorporation of new tools or skills
- Increased collaboration between RPAs
- Increased collaboration with external health partners
- Building public health capacity at my RPA (staff or knowledge)
- Building Health Impact Assessment-specific skills
- Increasing the TA capacity of my RPA
- Increasing Public Health content knowledge
- Other (please specify)
Thank you!

QUESTIONS?