Overview

1. Introduction
2. Health Impact Assessment Framework
3. Model Development and Application to 6 Cities
4. Active Transport Simulation
5. Summary
Introduction
MAJOR TRANSPORT CHALLENGES

51% → 70% Living in Cities
7 → 10.5 Billion Population
46% ↑ Road Deaths
Many Achievements....

Source: Australian Transport Council (2006)
Emerging OPPORTUNITY

Land-Use Decisions →
Transport Choice ↑ Road Trauma
Health Impact Assessment Framework
Application of a Health Impact Assessment Framework

- Engaged key stakeholders and obtained baseline population information
- Systematic search of the literature related to land-use, transport and population health (chronic disease and road trauma)
- Health impact evidence gathering
- Developed a linear model for which population health outcomes were derived
Model Development and Application to 6 Cities
Quantifying Elements of the Model

Stage 1: Land-use and Transport Mode Choice

- Meta-analytic research by Ewing and Cervero (2010) provided elasticities for the relationship between land-use and transport choice
  - **Density** – population density, residential unit density, intersection density,
  - **Diversity** – number of separate land uses (businesses etc) assigned to a specific area
  - **Distance** – the average shortest street routes from place of residence or workplace to the nearest public transport option
  - **Design** – refers to characteristics and layout of land including streets, intersection connectivity, footpaths, aesthetics
Quantifying Elements of the Model

Stage 2: Transport Mode Choice and Population Health

- We assessed influences of land-use and transport mode choice on the following population health outcomes
  - Road Deaths and Serious Injury (ICD-AM V00-V89)
  - Cardiovascular Disease (ICD-AM I00-I99)
  - Type 2 Diabetes (ICD-AM E10-E14)
  - Respiratory Disease (ICD-AM J30-J98)
Quantifying Elements of the Model

Stage 2: Transport Mode Choice and Population Health

- Key drivers of population health associated with transport mode choice identified from the systematic review were:
  - Per km exposure to risk of injury or death associated with the mode of travel in the current environment
  - Level of physical activity (as measured by metabolic equivalents (METS)) associated with the mode choice and its effect on cardiovascular disease and Type 2 diabetes
  - Exposure to fine particulate matter (PM$_{10}$ and PM$_{2.5}$) associated with emissions from transport

- For comparative purposes, population health outcomes were reported as disability adjusted life years (DALY’s)
Injury / Disease Outcomes
Risk Exposure
Land Use
Design
Land Transport Mode
Share
(Motor vehicle, Train, Bus, Pedestrian, Bicycle, Other)
Exposure to crash risk (risk per km of travel)
Exposure to pollution from emissions (PM10)
Physical activity associated with transport mode
Road trauma (deaths and serious injuries)
Chronic disease (CVD, T2 Diabetes, Respiratory disease)
Health and Wellbeing

Stage 1 - Land Use and Transport Mode Choice

Stage 2 – Transport Mode Choice and Health

Public policy initiatives, individual preference, mode availability, cost, demographics
Transport Mode Choice
Land Transport Mode Share
(Motor vehicle, Train, Bus, Pedestrian, Bicycle, Other)

Density
Diversity
Distance
Design
Baseline Model

- Data were obtained for 6 international cities
  - Melbourne
  - Delhi
  - Beijing
  - New York
  - London
  - Copenhagen
Baseline Model

• Data were obtained for 6 international cities
  
  o **Melbourne**
  
  o **Delhi**
  
  o **Beijing**
  
  o **New York**
  
  o **London**
  
  o **Copenhagen**
Baseline Model

- Data were obtained for 6 international cities
  
  - Melbourne
  
  - Delhi
  
  - Beijing
  
  - New York
  
  - London
  
  - Copenhagen
Baseline Model

- Data were obtained for 6 international cities

  - Melbourne
  - Delhi
  - Beijing
  - New York
  - London
  - Copenhagen
## Baseline Model: Transport Mode Share and Road Trauma

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>Melbourne</th>
<th>Risk of Death per km</th>
<th>Beijing</th>
<th>Risk of Death per km</th>
<th>Delhi</th>
<th>Risk of Death per km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of total km by mode</td>
<td>% of total km by mode</td>
<td></td>
<td>% of total km by mode</td>
<td></td>
<td>% of total km by mode</td>
</tr>
<tr>
<td>Vehicle Driver</td>
<td>60%</td>
<td>7.3 E-08</td>
<td>35%</td>
<td>2.5 E-08</td>
<td>10%</td>
<td>6.7 E-08</td>
</tr>
<tr>
<td>Vehicle Passenger</td>
<td>25%</td>
<td>7.2 E-08</td>
<td>7%</td>
<td>2.5 E-08</td>
<td>10%</td>
<td>6.7 E-08</td>
</tr>
<tr>
<td>Train</td>
<td>10%</td>
<td>5.8 E-10</td>
<td>21%</td>
<td>6.0 E-09</td>
<td>8%</td>
<td>4.3 E-08</td>
</tr>
<tr>
<td>Bus</td>
<td>2%</td>
<td>3.3 E-09</td>
<td>30%</td>
<td>6.0 E-09</td>
<td>48%</td>
<td>4.6 E-08</td>
</tr>
<tr>
<td>Walking</td>
<td>1%</td>
<td>7.5 E-08</td>
<td>1%</td>
<td>1.0 E-07</td>
<td>7%</td>
<td>1.9 E-08</td>
</tr>
<tr>
<td>Bicycle</td>
<td>1%</td>
<td>1.3 E-08</td>
<td>16%</td>
<td>1.9 E-07</td>
<td>7%</td>
<td>1.8 E-08</td>
</tr>
<tr>
<td>Other (including motorcycle)</td>
<td>1%</td>
<td>1.6 E-07</td>
<td>2%</td>
<td>1.6 E-07</td>
<td>10%</td>
<td>5.6 E-08</td>
</tr>
</tbody>
</table>
## Baseline Model: Transport Mode Share and Road Trauma

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>London</th>
<th></th>
<th>New York</th>
<th></th>
<th>Copenhagen</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of total km by mode</td>
<td>Risk of Death per km</td>
<td>% of total km by mode</td>
<td>Risk of Death per km</td>
<td>% of total km by mode</td>
<td>Risk of Death per km</td>
</tr>
<tr>
<td>Vehicle Driver</td>
<td>35%</td>
<td>1.6 E-09</td>
<td>39%</td>
<td>2.3 E-09</td>
<td>37%</td>
<td>2.4 E-09</td>
</tr>
<tr>
<td>Vehicle Passenger</td>
<td>19%</td>
<td>1.7 E-09</td>
<td>21%</td>
<td>1.9 E-09</td>
<td>16%</td>
<td>2.8 E-09</td>
</tr>
<tr>
<td>Train</td>
<td>29%</td>
<td>2.4 E-10</td>
<td>15%</td>
<td>8.2 E-11</td>
<td>24%</td>
<td>9.7 E-10</td>
</tr>
<tr>
<td>Bus</td>
<td>11%</td>
<td>6.2 E-10</td>
<td>8%</td>
<td>1.5 E-10</td>
<td>7%</td>
<td>3.4 E-09</td>
</tr>
<tr>
<td>Walking</td>
<td>4%</td>
<td>5.9 E-08</td>
<td>6%</td>
<td>3.3 E-08</td>
<td>3%</td>
<td>3.1 E-08</td>
</tr>
<tr>
<td>Bicycle</td>
<td>1%</td>
<td>4.3 E-08</td>
<td>1%</td>
<td>3.6 E-08</td>
<td>12%</td>
<td>5.7 E-09</td>
</tr>
<tr>
<td>Other (including motorcycle)</td>
<td>1%</td>
<td>1.3 E-07</td>
<td>10%</td>
<td>5.0 E-09</td>
<td>1%</td>
<td>3.4 E-08</td>
</tr>
</tbody>
</table>
Active Transport Simulation
Effects of Enhancing Land Use

Mode-Shift Model

- Under this scenario, we altered the baseline model to encourage active transport across the 6 cities. The model altered land use so that there was:
  - 30% increase in land-use density,
  - 30% increase in diversity, and
  - 30% decrease in average distance to public transport

- We also modelled the impact of public policy initiatives that resulted in 30% of VKT currently undertaken by vehicle drivers and passengers for short trips under 5km being transferred to cycling (66%) or walking (33%).
## Effects of Enhancing Land Use

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>Melbourne</th>
<th>Beijing</th>
<th>Delhi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Driver</td>
<td>-9%</td>
<td>-7%</td>
<td>-17%</td>
</tr>
<tr>
<td>Vehicle Passenger</td>
<td>-10%</td>
<td>-7%</td>
<td>-17%</td>
</tr>
<tr>
<td>Train/Tram</td>
<td>14%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Bus</td>
<td>14%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Walking</td>
<td>100%</td>
<td>125%</td>
<td>24%</td>
</tr>
<tr>
<td>Cycling</td>
<td>242%</td>
<td>18%</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in travel-related METS per week</td>
<td>22%</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Particulate Matter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in transport-related particulate emissions</td>
<td>-8%</td>
<td>13%</td>
<td>20%</td>
</tr>
</tbody>
</table>
### Effects of Enhancing Land Use

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>London</th>
<th>Copenhagen</th>
<th>New York</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Driver</td>
<td>-10%</td>
<td>-8%</td>
<td>-12%</td>
</tr>
<tr>
<td>Vehicle Passenger</td>
<td>-10%</td>
<td>-7%</td>
<td>-12%</td>
</tr>
<tr>
<td>Train/Tram</td>
<td>14%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Bus</td>
<td>14%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Walking</td>
<td>35%</td>
<td>18%</td>
<td>33%</td>
</tr>
<tr>
<td>Cycling</td>
<td>257%</td>
<td>15%</td>
<td>403%</td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in travel-related METS per week</td>
<td><strong>26%</strong></td>
<td><strong>11%</strong></td>
<td><strong>24%</strong></td>
</tr>
<tr>
<td><strong>Particulate Matter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in transport-related particulate emissions</td>
<td><strong>-1%</strong></td>
<td><strong>-1%</strong></td>
<td><strong>-5%</strong></td>
</tr>
</tbody>
</table>
# DALY’s Gained per 100,000 population
## Under Active Transport Scenario

<table>
<thead>
<tr>
<th>Change in Population Health Outcomes</th>
<th>Melbourne</th>
<th>Beijing</th>
<th>Delhi</th>
<th>London</th>
<th>Copenhagen</th>
<th>New York</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular Disease</td>
<td>62</td>
<td>-243</td>
<td>-838</td>
<td>84</td>
<td>40</td>
<td>98</td>
</tr>
<tr>
<td>Type 2 Diabetes</td>
<td>8</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Respiratory Disease</td>
<td>1</td>
<td>-21</td>
<td>-45</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Road Trauma</td>
<td>-8</td>
<td>-4</td>
<td>8</td>
<td>-13</td>
<td>0</td>
<td>-19</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>-263</td>
<td>-849</td>
<td>80</td>
<td>44</td>
<td>99</td>
</tr>
</tbody>
</table>
Effects of Road Safety Interventions under the Active Transport Scenario

![Bar chart showing road trauma DALYs gained per 100,000 population for different cities. The chart compares scenarios with and without road safety interventions. Melbourne, Beijing, Delhi, London, Copenhagen, and New York are listed on the x-axis. The y-axis represents the road trauma DALYs gained. The data shows a significant reduction in DALYs gained in Delhi and New York with road safety interventions, while other cities show varying degrees of improvement or no change.]
Summary
The HIA framework is useful to assess the health impact of land-use and transport policies

One approach is not applicable across all jurisdictions

Important points from this modelling

- Land-use and modal choice strongly linked to health outcomes
- Importance of infrastructure to ameliorate road trauma with increases in active transport
- Role road safety interventions contribute to reducing road trauma
- Importance of integrating the detail outlined from micro-simulation and driver models into the broader simulation modelling
Thank You

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