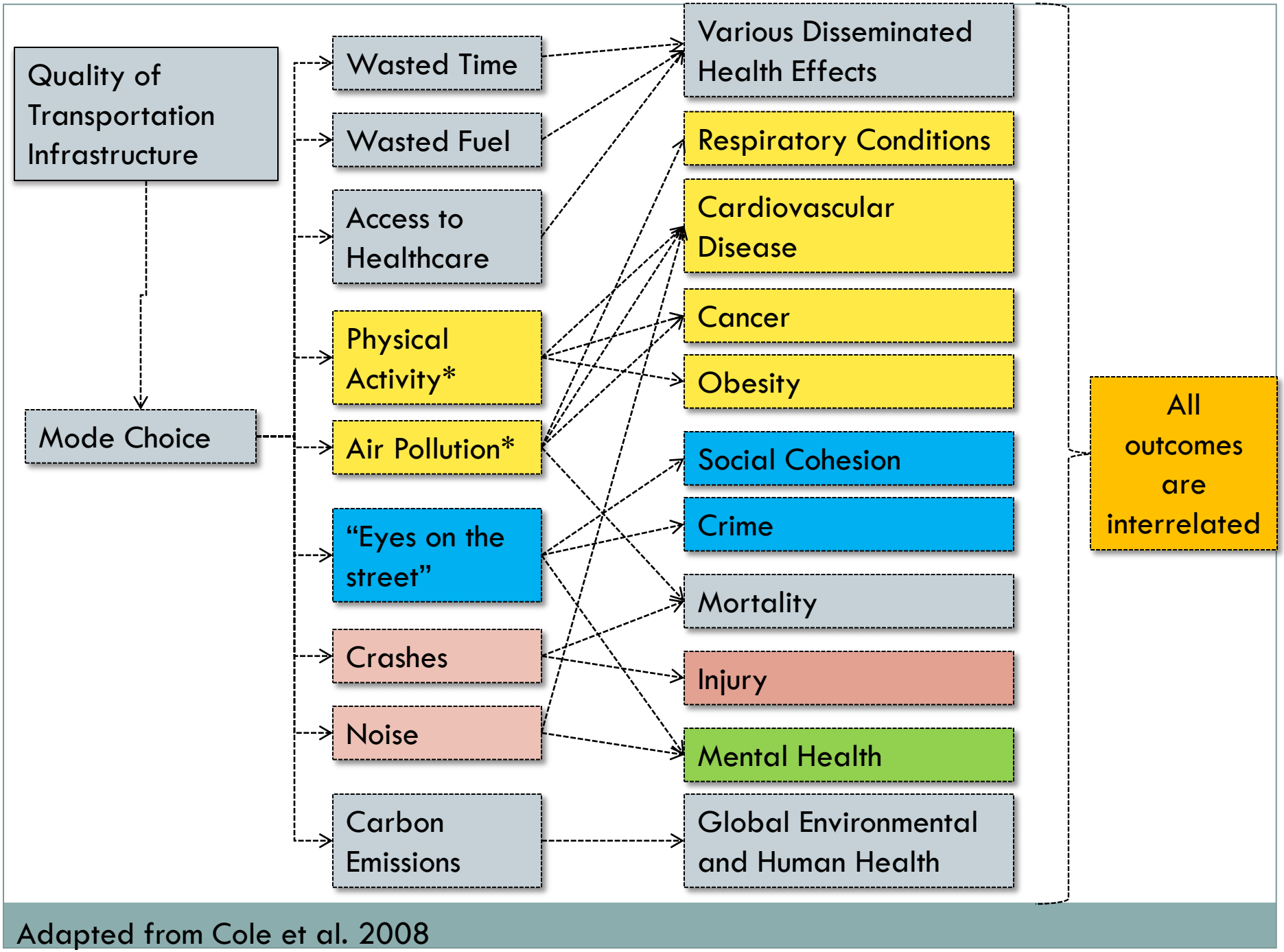
Transportation + Health

How Transportation Infrastructure Impacts Health

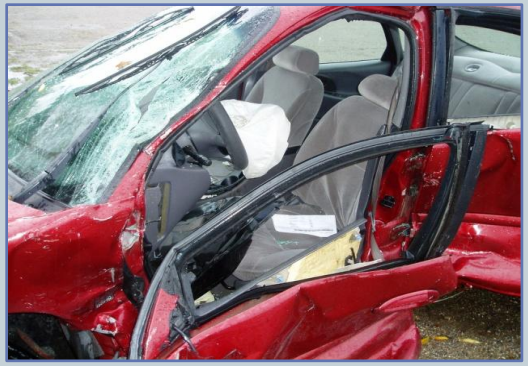
NOÉMIE SPORTICHE, MAPC
PETER JAMES, HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH



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

Annual Impact	Scenario Cost
Cost of additional time in traffic	$137.5 million
Cost of additional fuel burned	$22.7 million
Cost of additional car crashes, including crashes with bicycles and pedestrians	$33.6 million
Cost of additional mortality and hospitalizations for asthma, chronic lung disease, heart attacks, heart disease, and major cardiovascular events due to air pollution	$1.5 million
Cost of lives lost due to decreased physical activity	$74.9 million
Cost of carbon emissions	$1.9 million
Total annual cost	**$272.1 million**

Example derived from MAPC MBTA HIA

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 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

	SCENARIO
People who Shift from Transit to Driving per Year	30,400
Additional Time Driving per Year	18,500 hours (770 days)
Annual Cost of Wasted Time	$137.5 million

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

	SCENARIO
Deaths Caused by Worse Air Quality per Year	0.18
Hospitalizations Caused by Worse Air Quality per Year	0.17
Annual Cost of Exposure to Additional Air Pollution	$1.5 million

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 heath, 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

	SCENARIO
Lost Physical Activity	250,000 minutes per day
Lost Caloric Expenditure	8.2 million per day
Additional Cases of Obesity Caused by Sedentary Behavior per Year	70
Additional Deaths Caused by Sedentary Behavior per Year	9
Annual Cost of Lost Physical Activity	$75 million

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

*Elvik, R. 2012. "Speed Limits, Enforcement, and Health Consequences." *Annual Review of Public Health* 33 (April): 225–238. doi:10.1146/annurev-publhealth-031811-124634.

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

*Elvik, R. 2009. "The Power Model of the Relationship Between Speed and Road Safety: Update and New Analyses" (1034/2009) (October). http://trid.trb.org/view/2009/M/1150311.

Collisions, Injuries, and Fatalities

Estimated Annual Decrease based on a 1.8 MPH speed reduction	
Total Crashes	2,219
Fatal Crashes	15
Injury Crashes	772
Fatalities	18
Injured Road Users	1,239
Pedestrian Fatalities	4
Cyclist Fatalities	1
Injured Pedestrians	50
Injured Cyclists	33
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

Costs of Crashes

	Fatalities	Pedestrian Fatalities	Cyclist Fatalities
Annual Decrease in Deaths	18	4	1
Medical Cost Avoided	$346,721	$76,699	$18,912
Work Loss Cost Avoided	$29,347,334	$6,521,513	$1,630,641
Combined Cost Savings	$29,694,055	$6,598,212	$1,649,553

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

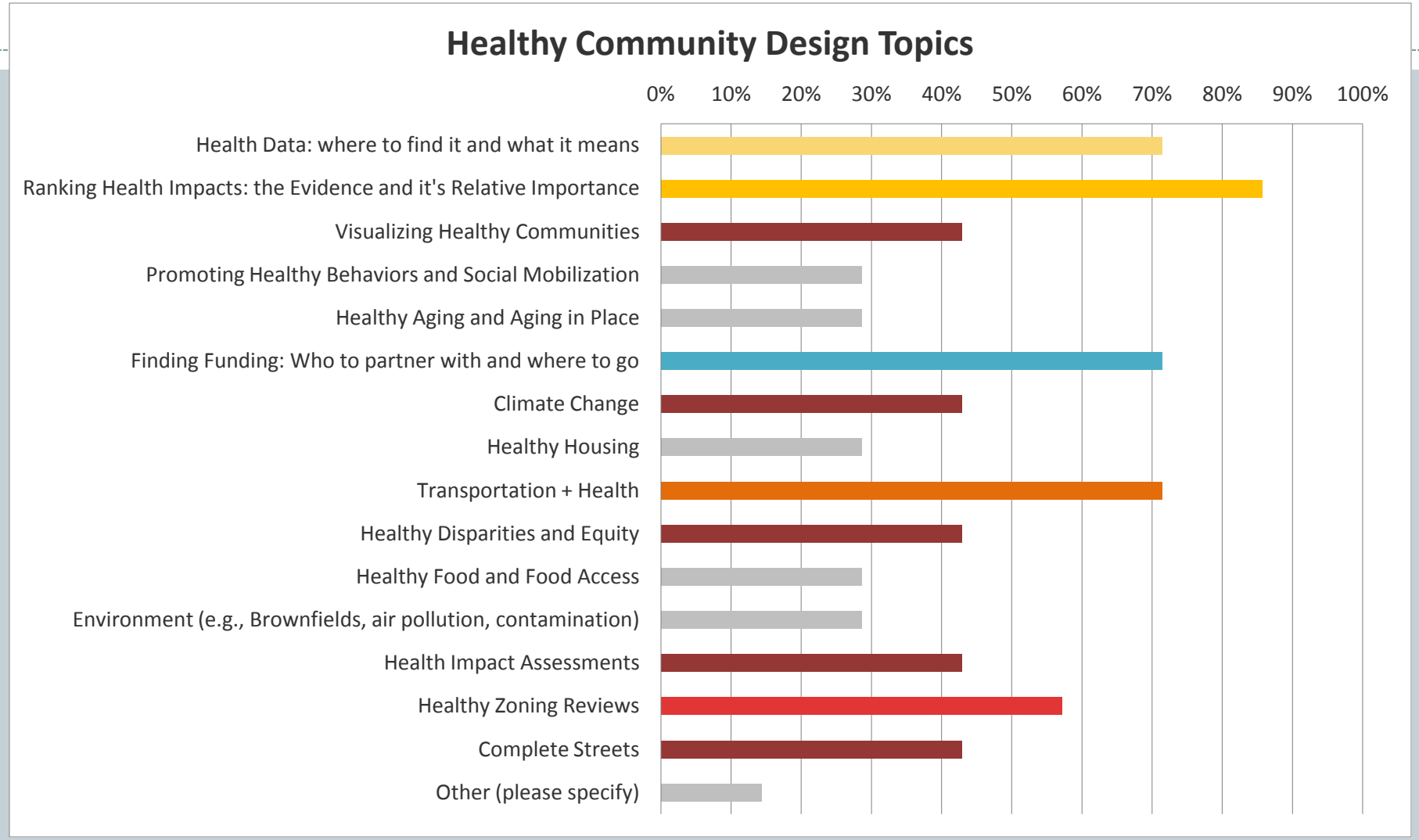
	Injured Road Users	Injured Pedestrians	Injured Cyclists
Annual Decrease in Number Hospitalized	1,239	50	33
Medical Cost Avoided	$63,872,373	$2,703,376	$1,652,705
Work Loss Cost Avoided	$116,610,789	$5,164,047	$3,766,654
Combined Cost Savings	$180,483,163	$7,867,423	$5,419,359

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

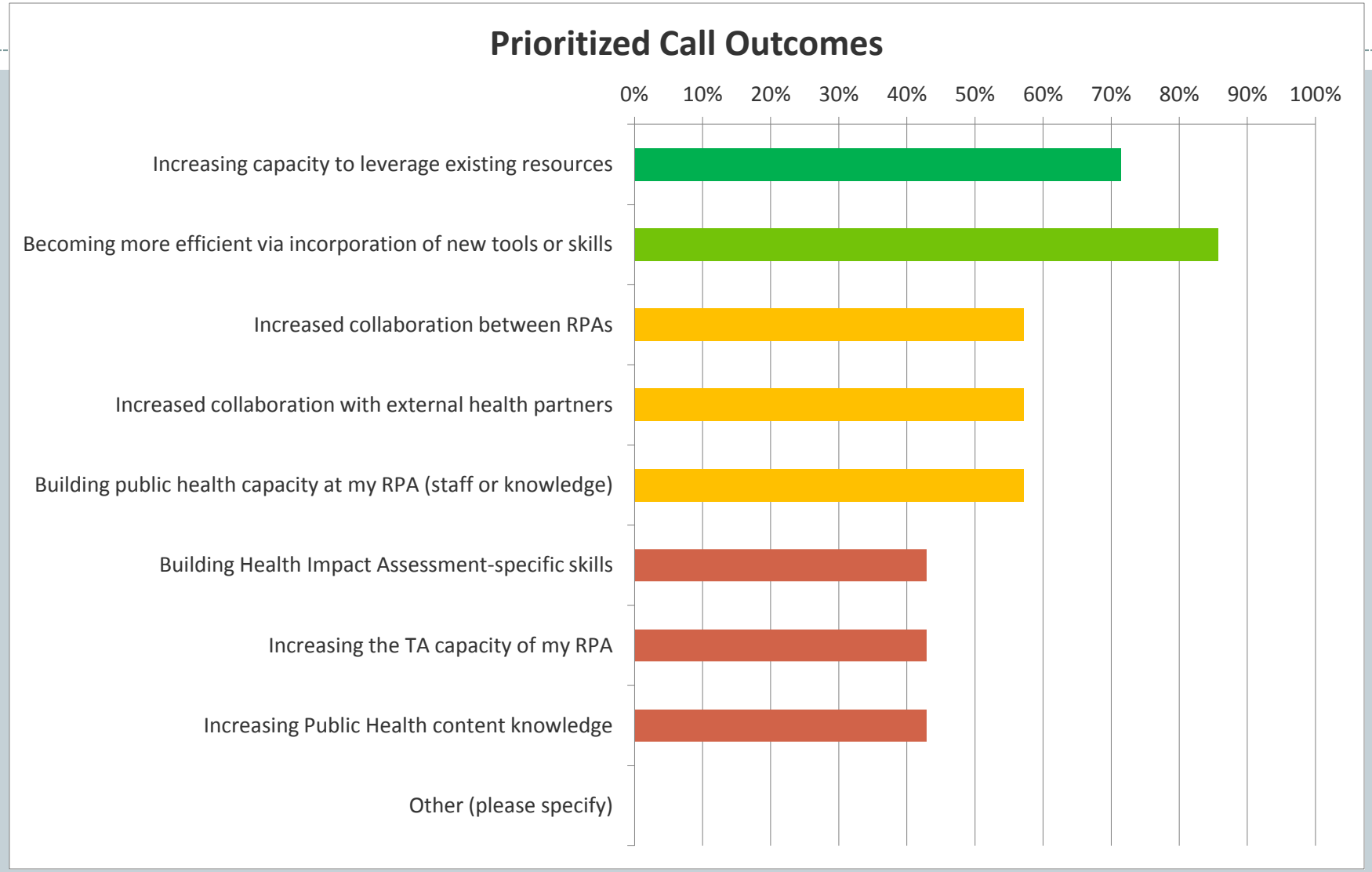
Survey Results



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



Thank you!

QUESTIONS?