



Expanding Public Transit in Columbia, Missouri

A Health Impact Assessment



prepared by the HIA Partner Team



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Executive Summary

Background

Policies and programs from domains such as transportation, planning, and education influence health and well-being. Health Impact Assessment (HIA) is an evidence-based research tool used to inform decision-makers about the potential health risks and benefits of policies, programs, and projects outside the health sector. HIA first identifies potential health effects and their likely distribution within the population. HIA then makes recommendations for how a proposed program or policy might be altered to increase positive and decrease negative health outcomes.

Increased student ridership, budget cuts, and rising fuel costs have stressed the current Columbia Transit system. In response to these challenges, several potential mechanisms have been proposed to increase funding and allow for expansion of bus services in Columbia. In light of these policy discussions, the Columbia/Boone County Department of Public Health and Human Services partnered with the PedNet Coalition and Central Missouri Community Action in late 2011 to perform an HIA on the health effects of expanding and improving bus service in Columbia. Funding was provided by grants from the Robert Wood Johnson Foundation and the Missouri Foundation for Health. The study introduces consideration of health effects and their distribution within the population to the ongoing conversation on the benefits of public transit to our community.

Project Goals

The core goals of the HIA project were to:

- Assess potential health effects of expanding public transit in Columbia.
- Determine likelihood of these health effects, given the best possible evidence.
- Provide recommendations for how transit expansion could maximize positive and minimize negative health outcomes.
- Increase awareness among decision-makers and within the community about how different policies and programs influence health.
- Promote the use of HIA as a decision-making tool among policymakers and other stakeholders.

Project Methods

The specific research question addressed by this HIA is: *“How will expansion of Columbia Transit services impact community health?”* The HIA Partner Team met in Spring 2012 to define the scope of the project and identify four indicators found to influence health that were also determined most likely to be affected by expansion of public transit. These four health indicators are:

- Physical activity
- Exposure to the outdoors
- Access to health care, employment, education, and healthy food options
- Creation of a livable and sustainable community

The assessment used a variety of data sources. We performed literature reviews, held meetings with community members and stakeholders, and gathered our own data to determine how these health indicators might be altered by expanding public transit. Health data sources also consulted were the Behavioral Risk Factor Surveillance System and County Health Rankings. We gathered our own data through community meetings held by PedNet, titled Community Conversations about Transit. These meetings took place in four of six city wards during the Spring of 2012. We also partnered with Central Missouri Community Action to conduct a community-based survey about

transportation difficulties and access to health care and employment among low-income central city residents, bus users, and clients of local health and social service agencies.

Key Stakeholders

We collaborated with the following government and community stakeholders during the preparation of this report.

- City of Columbia
 - Office of the City Manager and Deputy City Manager
 - Department of Public Health and Human Services
 - Office of Sustainability
 - Columbia Transit
 - Department of Community Development
- Boone County Commission
- Columbia Public Schools

Key Findings and Recommendations

- Review of the literature found solid evidence to suggest that those who use public transit accrue more physical activity throughout the day, by walking or biking to and from bus stops. Therefore, expanding bus services while concurrently improving infrastructure that allows for active transportation has potential positive impacts for local health.
- Other positive health impacts from expanding transit include improving access to health care; improving access to employment, which could improve access to health care benefits and also reduce stress.
- Improving access to healthy foods, particularly in areas designated as food deserts.
- Expanding transit could also increase community cohesion and social capital by providing more opportunities for social interaction. Better social capital, defined as the resources accrued through social interaction, is linked with improved health.

Although analysis is limited to the four health indicators identified in the Project Methods section, we found no evidence to suggest that expanding bus services in Columbia would negatively impact community health.

In addition, it is important to note that the potential health effects of transit expansion fundamentally depend on:

- The degree to which bus services are expanded
- The impact on bus ridership due to transit expansion

In other words, it is impossible to quantify the health effects of transit expansion without first knowing the amount of funding available for transit expansion and how that funding will be dispersed to improve transit services. Therefore, the findings and recommendations from our HIA focus on how transit might best be altered or expanded to maximize impacts on community health and increase ridership, which would consequently impact health through increased physical activity, improved access to the outdoors, or accrual of social capital.

In addition, primary survey data and key informant interviews found that most bus riders lack alternate transportation options, such as a reliable car. Any expansion or alteration of transit services should therefore carefully consider impacts on the population currently dependent on the bus for access to education, health care, employment, or retail.

Table 1 presents the key HIA findings and provides recommendations to maximize benefits to community health. Table 2 is the Evidence Quality Legend. Table 3 assesses the quality of the evidence and the likelihood of the identified health impacts.

Table 1: Key HIA Findings and Recommendations

1. Physical Activity	
Expanding bus services in Columbia could increase physical activity levels among those who ride the bus.	
Findings	Recommendations
Transit riders often walk for greater periods of time than do car drivers, nearly attaining daily recommendations for physical activity. Residents of transit-oriented developments consistently have higher levels of active transportation use and physical activity. Complete streets ordinances can potentially complement public transportation systems, allowing for more opportunities for physical activity as well as expanded range of travel for users.	<ol style="list-style-type: none"> 1 Review current bus routes to include more opportunities for ridership in densely populated areas of Columbia. 2 Promote collaboration between Columbia Transit and the Health Department on production of social marketing materials describing the physical activity benefits of bus use, and disseminate materials through local media and on buses. 3 Ensure there are bike racks at major Columbia Transit hubs.

Table 1 Cont.

2. Exposure to the Outdoors	
Expanding bus services in Columbia could increase exposure to outdoor recreational areas, such as parks and trails, among those who ride the bus.	
Findings	Recommendations
Living in close proximity of parks and recreational areas is associated with greater usage, increased opportunities for physical activity, and decreased stress. Park users are more likely to meet physical activity recommendations. A Columbia Parks & Recreation survey found that 99% of those surveyed visited at least one city park in the past year and indicated primary use of these areas for adult and youth sports. However, only 24% respondents indicated that park facilities were close enough to their residence, while 29% indicated there were no parks within walking distance from their residence.	<ol style="list-style-type: none"> 1 When new bus routes are designed, access from neighborhoods to parks should be maximized, while considering other goals of transit system design. 2 Post bus routes and timetables at parks already serviced by existing bus routes.

Table 1 Cont.

3. Access to health care, employment, education, and healthy food options	
Expanding bus services in Columbia could increase access to health care facilities, employment, education, and retail outlets that provide healthy food options.	
Findings	Recommendations
Public transportation is considered one of the most important social determinants of health. Results of local surveys found that the strongest predictor of missing health care appointments was a transportation problem, followed by the frequency of current bus service.	<ol style="list-style-type: none"> 1 When new bus routes are designed, access from neighborhoods to health care facilities, including hospitals and clinics, should be maximized, while considering other goals of transit system design.
Availability of transportation can put limits on where residents search for employment. Results of local surveys found that those who currently use the bus, they often searched for employment opportunities that were in proximity to current bus routes. Respondents who did not own a car reported missing work more frequently than those with cars.	<ol style="list-style-type: none"> 1 Create a “Transit Access To Employment” group consisting of representatives from the business community and populations using Columbia Transit to address barriers to accessing employment. 2 Appoint a member to the Public Transportation Advisory Commission who is a representative of the business community.
Lack of transportation can be a barrier to accessing education. In Columbia, limited evening hours make it difficult or impossible for transportation disadvantaged students to take the bus to locations, such as the Career Center, that provide job training and GED classes. In interviews, local Head Start administrators also identified transportation as a major barrier to consistent attendance, a requirement for Head Start students.	<ol style="list-style-type: none"> 1 Assess the need for transportation among potential students of GED or job training classes and determine areas of Columbia where clusters of these students reside. 2 Coordinate bus routes and add evening hours to locations that provide GED classes or job training, and that enroll a large percentage of students who lack transportation.

Findings	Recommendations
<p>Consumers, especially those who are low-income, experience transportation barriers to accessing healthy food options. Recent food asset mapping of Columbia found that many low-income residents use public transportation to travel to stores that provide healthy food options, especially if the store was greater than one mile from their location.</p>	<ol style="list-style-type: none"> 1 Continue the farmer's market bus route and collaborate with the health department to promote the route to residents within areas classified as food deserts. 2 When new routes are designed, maximize access from neighborhoods to stores that provide healthy food options, while considering other goals of transit system design.
<p>Lack of safe, reliable transportation is one of the most significant barriers to participation in after-school programs. Participation in after-school programs is linked with improved educational outcomes.</p>	<ol style="list-style-type: none"> 1 Coordinate with Columbia Public Schools to provide transportation to students participating in after-school activities, particularly secondary school students.

Table 1 Cont.

4. Creation of a livable and sustainable community	
Expanding bus services in Columbia could promote walkable communities or transit-oriented development and increase opportunities for social interaction and accrual of social capital.	
Findings	Recommendations
The design and layout of the built environment can influence crime via allowing access for perpetrators, ease of entry and exit, and surveillability. Variables associated with higher crime rates include bus stops at undesirable locations (such as liquor stores), vacant buildings, and the level of litter. Variables associated with lower crime rates around bus stops include large commercial buildings, areas with high visibility, bus shelters, and the presence of street traffic and pedestrians.	<ol style="list-style-type: none"> 1 Audit current bus stops to determine if they are near undesirable locations.
Bus stop characteristics such as layout, visibility, and lighting can influence the perception of safety. In Columbia, more than a quarter of those surveyed also identified “safer buses” as a preferred improvement. Perception of safety was also a barrier to bus ridership among participants at the Community Conversations about Transit.	<ol style="list-style-type: none"> 1 Create an “adopt-a-bus stop” program with volunteers to address conditions surrounding identified stops, such as lack of shelter from the elements, litter, and other aesthetic considerations. 2 Solicit feedback about perceived safety from transit user focus groups and incorporate into training for bus drivers, such as strategies on addressing noisy or disruptive youth.

<p>Residents of mixed used developments report higher levels of social capital due to their design, which encourages walking and active transportation. Identified health benefits of social capital include prolonged life, better overall health, and improved mental health.</p>	<ol style="list-style-type: none">1 Partner with the Department of Community Development to review zoning procedures that would promote transit-oriented developments along transit corridors.2 Create a taskforce to research possible regulations to promote active transportation in central Columbia, including one-way streets, streets blocked to vehicles, or park-and-ride locations on the outskirts of the District.
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Table 2: Evidence Quality Legend

Expected Change Based on Literature	<ul style="list-style-type: none"> • No change – The literature achieves consensus that this indicator will likely remain unchanged. • Mixed – The literature lacks consensus about this indicator’s potential impact. • Increase – The literature achieves consensus that this indicator will likely increase. • Decrease – The literature achieves consensus that this indicator will likely decrease • N/A – There is no available literature on this indicator.
Stakeholder Projections	<ul style="list-style-type: none"> • No change – Stakeholders did not anticipate any changes. • Mixed – Stakeholders were divided in their opinions. • Increase – Stakeholders anticipated an increase. • Decrease – Stakeholders anticipated a decrease. • N/A – Stakeholders did not express their opinions.
Expected Health Impact	<ul style="list-style-type: none"> • Positive – Changes that may improve health. • Negative – Changes that may impair health. • Mixed – Changes may be both positive as well as negative. • Uncertain – Unknown how health will be impacted. • No effect – No identified impact on health.
Magnitude of Impact	<ul style="list-style-type: none"> • Low – Affects very few people. • Medium – Affects large numbers of people. • High – Affects many people.
Likelihood of Impact	<ul style="list-style-type: none"> • Likely – Likely that impacts will occur as the result of the proposal. • Possible – Possible that impacts will occur as the result of the proposal. • Unlikely – Unlikely that impacts will occur as the result of the proposal. • Uncertain – Uncertain that impacts will occur as the result of the proposal.
Distribution Within the Population	The population most likely to be affected by the changes in health factors or outcomes.
Quality of Evidence	<p>**** More than five strong studies.</p> <p>*** Five or more moderate studies.</p> <p>** Five weak studies.</p> <p>* Fewer than five studies.</p>

Table 3: Evidence Quality

Health Factor or Outcome	Expected Change Based on Literature	Stakeholder Projections	Based Primarily on Evidence From Literature				Quality of Evidence
			Expected Health Impact	Magnitude of Impact	Likelihood of Impact	Distribution	
1. Physical Activity							
More walking to bus stops	Increase	Increase	Positive	Correlated with magnitude of transit expansion	Likely	Current and anticipated riders	****
Transit-oriented development	Increase	N/A	Positive	Low	Likely	Those who live, work, or visit transit-oriented development	****
More complete streets and multi-modal design	Increase	Increase	Positive	High	Likely	Potentially entire population of Columbia	***

Table 3 Cont.

Health Factor or Outcome	Expected Change Based on Literature	Stakeholder Projections	Based Primarily on Evidence From Literature				Quality of Evidence
			Expected Health Impact	Magnitude of Impact	Likelihood of Impact	Distribution Within the Population	
2. Access to Outdoors							
Access to parks and recreation	Increase	Increase	Positive	High	Likely	Correlated with magnitude of transit expansion	**

Health Factor or Outcome	Expected Change Based on Literature	Stakeholder Projections	Based Primarily on Evidence From Literature				Quality of Evidence
			Expected Health Impact	Magnitude of Impact	Likelihood of Impact	Distribution Within the Population	
3. Improved accessibility to health care, employment, education, healthy food options							
Access to health care	Increase	Increase	Positive	Low	Uncertain	Transportation disadvantaged	**
Access to employment	Increase	Increase	Positive	Low	Uncertain	Transportation disadvantaged	**
Access to education	Increase	Increase	Positive	Medium	Possible	Transportation disadvantaged	**
Access to healthy food options	Increase	Increase	Positive	Low	Possible	Transportation disadvantaged	**
Access to after school activities	Increase	Increase	Uncertain	Low	Uncertain	Transportation disadvantaged	*

Table 3 Cont.

Health Factor or Outcome	Expected Change Based on Literature	Stakeholder Projections	Based Primarily on Evidence From Literature				Quality of Evidence
			Expected Health Impact	Magnitude of Impact	Likelihood of Impact	Distribution Within the Population	
4. Livable and sustainable community							
Crime (or perception of crime)	Decrease	Mixed	Uncertain	N/A	Uncertain	Entire community	*
Social capital	Increase	Increase	Positive	Low	Possible	Bus riders and neighborhoods on bus routes	***

Table of Contents

Acknowledgements.....	page 17
Introduction.....	page 20
Profile of Columbia.....	page 24
Transit Expansion HIA.....	page 28
Review of Evidence.....	page 36
Next Steps.....	page 59
Conclusion.....	page 61
References.....	page 62
Appendix 1: Community Survey.....	page 69

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Introduction

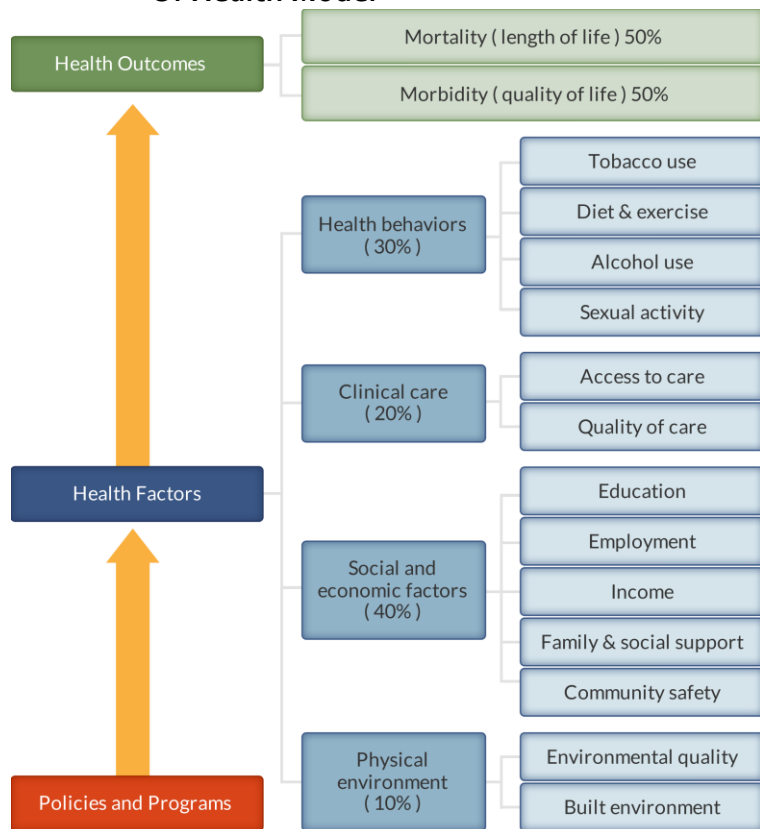
Health Impact Assessment, or HIA, is a “systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of the effects within the population. HIA provides recommendations on monitoring and managing those effects” (National Research Council, 2011). Simply put, HIA is an evidence-based research tool used to inform decision-makers about the unintended health effects of a potential decision before it is made. An HIA also includes recommendations to ensure that the planned policies, programs, and projects being studied maximize health benefits and minimize negative health impacts. It is important to note that HIA is not an advocacy tool. It is to be used strictly to inform the decision-making process so that the final policy or program maximizes health outcomes and minimizes adverse effects. An HIA is also based on the best available evidence, both quantitative, such as surveys, and qualitative, such as in-depth interviews with stakeholders.

An HIA can be performed in a number of ways to accommodate available resources and the time frame for the decision. A rapid HIA can be performed in a few weeks or a month. Generally, a rapid HIA is conducted for a less complex decision, and the evidence gathered may be only a few literature reviews and expert opinions. Intermediate and comprehensive HIAs focus on more complex policies and decisions. Therefore, more time is required to perform literature reviews, gather expert and stakeholder opinions, collect new primary data, and inform decision-makers. Our HIA could be considered intermediate, as we had a greater length of time to perform the previously mentioned activities, but we were not able to collect primary data for every health pathway.

The World Health Organization defines health as “a state of complete physical, mental, and social well-being, and not merely the absence of disease.” Policies made outside of the health sector

have traditionally not considered potential impacts on health. Health Impact Assessment has been identified by a number of international and domestic organizations as a tool for public health professionals and policy makers to address the “social determinants of health” (Figure 1). Poverty, education, policy and regulation, neighborhood context, and other social and environmental factors that influence health outcomes are grouped under the term social determinants of health (Berkman & Kawachi, 2000). These different environments affect our overall quality of life and can protect populations or put them at risk for certain types of diseases. For example, living in a neighborhood with poor access to healthy food options increases residents’ risk for type II diabetes.

Figure 1: County Health Rankings Social Determinants Of Health Model



A goal of HIA is to highlight the social determinants of health and the health disparities they contribute to within populations.

Steps of an HIA

A health impact assessment is typically performed in six steps. These steps include screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation.

County Health Rankings model ©2012 UWPHI

Screening

Screening assesses the value, feasibility, and utility of performing an HIA. If the plan or policy is too vague or not fully developed, or the potential health impacts are already known, an HIA will add little value to the decision. Staff, potential collaborative partners, available resources, and time must also be considered during screening. Given the number of state or local policies, plans, and projects under consideration, an HIA simply cannot be performed on each one. One of the most important questions to ask during the screening phase is: What specific program, plan, or policy decision will the HIA address? As with every step in the HIA, the screening process should be documented.

Scoping

Scoping creates the formal plan and timeline for conducting the HIA. There are many important tasks that need to be performed at this stage. Essential tasks include establishing roles for members of the HIA partner team, establishing goals for the HIA, identifying vulnerable populations, identifying geographic boundaries, formulating research questions, and identifying the potential health impacts of the decision to be evaluated. In addition, creating a causal model or pathway diagram of possible decision scenarios and how it impacts health will help to aid the research question.

Assessment

Assessment is performed in two steps. The first step involves gathering data to describe the baseline conditions of the groups involved in the decision. Examples of baseline data sources include the U. S. Census, the Behavioral Risk Factor Surveillance Survey (BRFSS), and additional national or local surveys of health status and outcomes. The next step of the assessment stage is to gather, weigh, and evaluate data relevant to the decision being studied. Analytic resources used at this stage include peer-reviewed literature, government reports, interviews or focus groups, and new data collected expressly to address the research questions posed in the HIA. Assessment should be

impartial and should involve weighing both the positive and negative health impacts of the decision. The potential health effects are then characterized as to their likelihood, severity, magnitude, and distribution within the population based on empirical evidence, the baseline assessment, and other forecasting tools. Once the health effects are weighed, the confidence level or certainty that each health effect will occur if the policy is adopted is judged based on the supporting evidence.

Recommendations

Recommendations identify the ways the decision or decision alternatives should protect and promote health. The recommendations should be practical, feasible, and inform decision-makers of the risks, benefits, and potential costs of the decision and its alternatives. The HIA team may need to bring in outside expertise from individuals or groups related to the project to create realistic recommendations.

Dissemination

A comprehensive HIA report should be transparent and include all of the participants, their roles, and the previously discussed steps. The report should be written in a suitable language for target audiences such as community members, stakeholders, and elected officials. The findings of the HIA should be disseminated to decision-makers, stakeholders, and affected communities.

Monitoring and Evaluation

Health Impact Assessments can be evaluated in three ways. The first is a process evaluation. This evaluation can provide details such as how the HIA was performed, what data sources were used, how recommendations were formulated, and how did the decision-makers use the recommendations. The second form of evaluation is impact evaluation. This assesses the impact made by the HIA on the decision-making process. Finally, outcome evaluation assesses and monitors the impact of the decision on the health status of identified populations.

Profile of Columbia

Columbia is the largest city in both Boone County and mid-Missouri, and it serves as the county seat. With a population of 108,500, it is the fifth-largest city in Missouri. Its population is a majority of the population of Boone County's population, which is 162,642.

Table 4: City, County, and State Demographic Characteristics

	Columbia	Boone County	Missouri
Population, 2011 estimate	110,438	165,627	6,010,688
Population, % change, April 1, 2010 to July 1, 2011	1.8%	1.8%	0.4%
Population, 2010	108,500	162,642	5,988,927
Age, % of population			
Under 5 years	6.0%	6.1%	6.4%
Under 18 years	18.8%	20.7%	23.5%
Under 65 years	8.5%	9.4%	14.2%
Female persons, % of population	51.7%	51.5%	51.0%
Race, % of population			
White	79.0%	83.6%	84.0%
Black or African American	11.3%	9.4%	11.7%
American Indian/Alaska native	0.3%	0.5%	0.5%
Asian origin	5.2%	3.9%	1.7%
Native Hawaiian/other Pacific Islander	0.1%	0.1%	0.1%
Two or more races reported	3.1%	2.7%	1.9%
Ethnicity, % of population			
Hispanic or Latino origin	3.4%	3.2%	3.7%
White, non-Hispanic or Latino origin	77.0%	80.9%	80.8%
Foreign-born persons, % of population, 2006-2010	8.1%	5.9%	3.7%
Language other than English spoken at home, % of population older than 5 years, 2006-2010	10.7%	8.1%	5.9%
High school graduates, % of population older than 25 years, 2006-2010	92.6%	91.9%	86.2%
Bachelor's degree, % of pop.	51.6%	45.2%	25.0%

Number of veterans, 2006-2010	N/A	10,616	511,253
Mean travel time to work (minutes), workers age 16+, 2006-2010	16	17.8	23.2
Number of housing units, 2011	NA	69,961	2,723,415
Homeownership rate, 2006-2010	48.5%	57.6%	70.0%
Housing units in multi-unit structures, %, 2006-2010	39.9%	30.6%	19.6%
Median value of owner-occupied housing units, 2006-2010	\$164,700	\$153,900	\$137,700
Number of households, 2006-2010	42,114	63,420	2,349,955
Mean number of persons per household, 2006-2010	2.26	2.34	2.45
Per capita money income in past 12 months (2010 dollars), 2006-2010	\$23,859	\$25,124	\$24,724
Median household income 2006-2010	\$41,287	\$45,786	\$46,262
Poverty level, % of population, 2006- 2010	22.9%	18.4%	14.0%

Data from the U. S. Census, 2010

Columbia lies almost equidistant between the two largest cities in the state, Kansas City and St. Louis, and is about 30 miles north of the state capital of Jefferson City. The City is home to the University of Missouri, the flagship school of the University of Missouri system, as well as Columbia College and Stephens College.



Boone County was ranked ninth overall in the 2012 County Health Rankings out of 115 counties in Missouri. Because of the sizable medical network in Columbia, the number of persons per physician in the county is 559:1, less than half the overall state ratio of 1,274:1 (national benchmark = 631:1). Eighty-six percent of the county's population has graduated from high school, and 75% have received some college education (national benchmark = 68%, state mean = 61%). However, the county does mirror some state and national trends for negative health behaviors. Adult smoking in the county is at 19.0%, similar to the national

rate at 19.3%, but below the state rate of 21.1%. Missouri has the eleventh-highest rate of adult smoking in the nation. According to the 2011 Missouri Department of Health and Senior Services BRFSS, about 28% of Missouri adults participated in no leisure time physical activity. Only one-half (49.5%) of Missouri adults achieved the recommended amount of daily physical activity. Relatedly Missouri is the eleventh-most obese state with an adult rate of 30.3%, and the tenth-most inactive state with regard to physical activity. If the current obesity trend continues, Missouri is projected to have an adult obesity rate of 61.9% by 2030. Missouri's obesity-attributable direct health care cost per adult is among the highest in the nation. The state is projected to spend \$761 per person in 2013 and \$1,834 per person by 2018 (Thorpe, 2009). However, Boone County does have slightly lower rates of adult inactivity (21%) and obesity (28%) compared with overall state averages (2012 County Health Rankings).

Table 5: Local and State Health Outcomes Compared to the National Benchmark

Health Outcomes	Boone County	Missouri	National Benchmark *
Poor or fair health, % of population	12%	16%	10%
Poor physical health days, mean days/mo	2.9/mo	3.6/mo	2.6/mo
Poor mental health days, mean days/mo	3.4/mo	3.7/mo	2.3/mo
Adult smoking, % of population	19%	24%	14%
Adult obesity, % of population	28%	31%	25%
Physical inactivity, % of population	21%	28%	21%
Motor vehicle crash death rate	16/100,000	19/100,000	12/100,000
Uninsured, % of population	13%	15%	11%

Primary care physician to total population ratio	559:1	1,274:1	631:1
Preventable hospital stays**	55	75	49
High school, % of population	86%	86%	NA
Some college, % of population	75%	61%	68%
Unemployment, % of population	6.40%	9.60%	5.40%
Children in poverty, % of population	17%	21%	13%
Inadequate social support, % of population	18%	19%	14%
Violent crime	433/100,000	518/100,000	73/100,000
Limited access to healthy foods, % of population	16%	8%	N/A
*The National Benchmark is the 90th percentile for all counties.			
**Preventable hospital stays are measured as the hospital discharge rate for ambulatory care-sensitive conditions per 1,000 Medicare enrollees.			

Data from the County Health Rankings Web site (www.countyhealthrankings.org).

Transit Expansion HIA

Screening

Screening for this HIA took place during the Summer of 2011. At that time, it became apparent that Columbia Transit had almost exhausted the reserve fund it had been using since 2007 to help fund operations. From 2007 to 2011, Columbia Transit encountered increased fuel costs as well as unexpectedly high demand from University of Missouri student riders. During that period, student ridership increased 700% with the addition of the “Black and Gold” bus routes, earning Columbia Transit several state awards for ridership. However, fares on these two routes were offered at well below cost. In order to avoid depleting the reserve fund during the fiscal year of 2012, service cuts and fare increases were proposed.

Through the diligent work of the Columbia City Council, budget adjustments were made to preserve services at approximately the same level through September 30, 2012. Concurrently, however, fares increased for both student and non-student riders. Also during this time, the Transit System Task Force was established by the Mayor of Columbia. This ad hoc group was created in the fall of 2011 to explore a potential transit partnership between the City and the University of Missouri.

During this time the PedNet Coalition applied for and received funding from the Robert Wood Johnson Foundation’s Roadmaps to Health Community grant. PedNet was one of only 12 organizations nationwide, and the only one from Missouri, to receive funding. The grant helps to address County Health Rankings findings. County Health Rankings are published each year through collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute. These data compare the health of all counties in the United States. The PedNet grant proposal focused on conducting an HIA to inform policy and decision-makers about

the likely health effects of expanding public transit services in Columbia. The grant also proposed initiating discussions about how to sustain the use of HIAs in Columbia and Boone County. Matching funds to carry out the HIA were received by Central Missouri Community Action (CMCA) via the Healthy and Active Communities Support for Local Policy Change grant from the Missouri Foundation for Health (MFH). The Columbia/Boone County Department of Public Health and Human Services contracted with PedNet and CMCA to conduct the HIA and other activities described in the grant, and the HIA Partner Team, consisting of staff from all three organizations, was created.

Scoping

The scope of the HIA was determined by the HIA Partner Team. During this phase, participant roles, research questions, data sources, and target populations were identified.

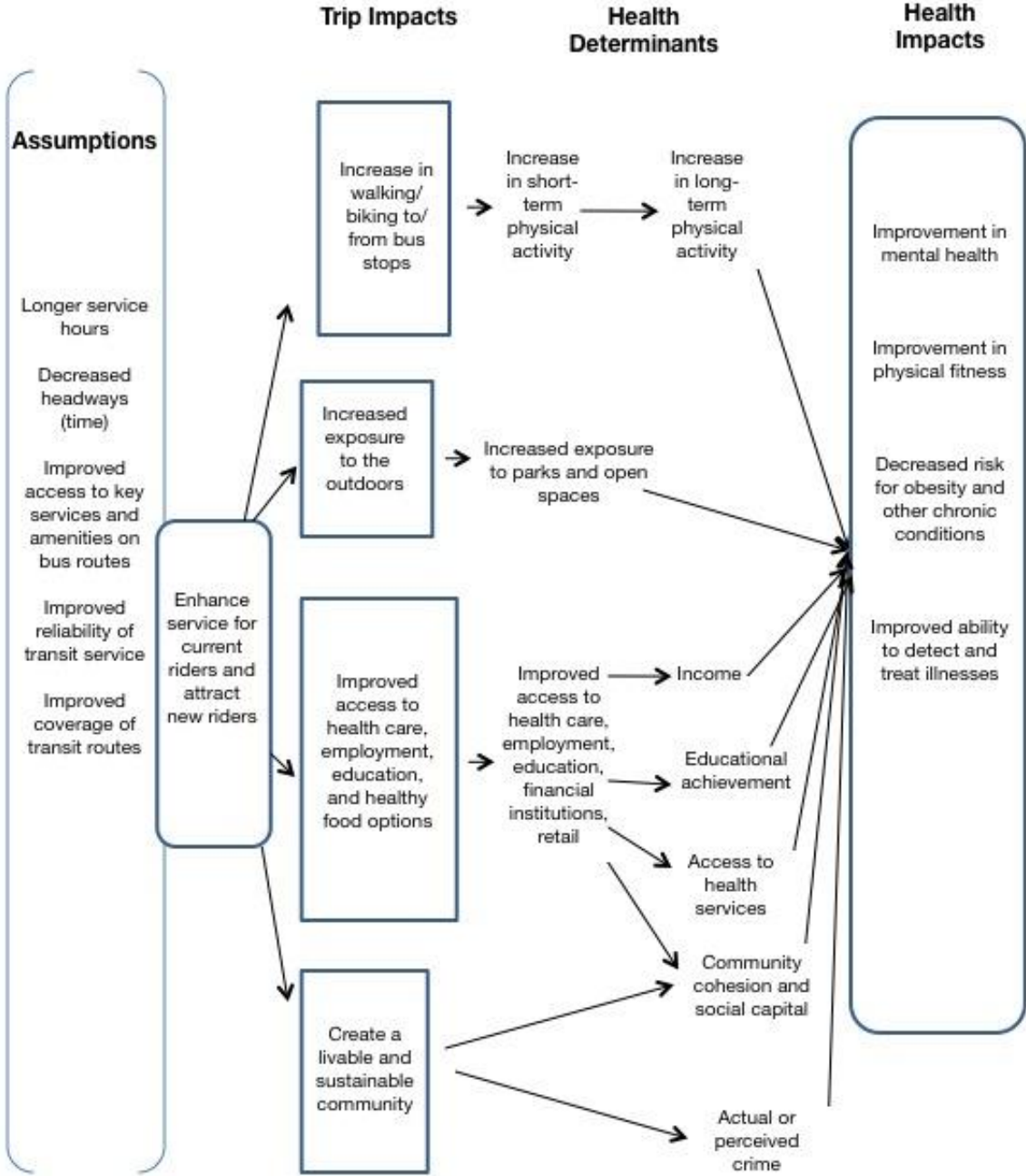
Roles. HIA staff from the Health Department directed the HIA process, including data collection, dissemination of results, and other communications related to the transit HIA and the sustained use of HIAs in the community. Staff from PedNet and CMCA would assist in data collection and build support for HIAs within the community.

Target Population. The population targeted by the HIA is individuals and families living at or below 200% of the Federal Poverty Level, or those with annual incomes below \$38,180 for a family of three. Although many in the population qualify for half-price bus fares, transportation remains a significant barrier. In addition, a second population identified during scoping was individuals and families who are not currently transit users, but who would potentially become users if service were expanded. This population will be discussed further in the stakeholder engagement section. Because Columbia Transit bus routes serve many different populations of varying health status within the city, a baseline health assessment was created using county-level data.

Health Determinants. Four primary health determinants were determined by the HIA Partner Team to be most likely affected by expanding bus service in Columbia.

- Physical activity
- Exposure to the outdoors
- Access to health care, employment, education, and healthy food options
- Creation of a livable and sustainable community

Logic Model Depicting Policy Impacts, Health Determinants, and Related Health Impacts



Based on these health determinants, our research question is as follows: “How will expansion of Columbia Transit services impact community health?”

Research Methods. A number of research methods were used for the HIA. We evaluated peer-reviewed literature published in academic journals, gathered reports and information from third-party sources, interviewed topic experts and community stakeholders, used Geographic Information System mapping, and collected and analyzed new data. Third-party sources included but were not limited to the Centers for Disease Control and Prevention, Robert Wood Johnson Foundation, and the American Public Health Association. We also used focus group data compiled from the PedNet-sponsored Community Conversations about Transit, which will be discussed further in stakeholder engagement.

Stakeholder Engagement. The HIA Partner Team engaged stakeholders in a variety of ways. Prior to the Partner Team creating the formal HIA plan during the scoping phase, PedNet held four Community Conversations about Transit between February and May, 2012. These community meetings were hosted by different members of the Columbia City Council at a location in their corresponding city ward. All four conversations included a total of 183 participants. The purpose of the conversations was to engage community members, elected leaders, and City staff to identify short- and long-term visions, challenges, and actions that could be taken to address public transit challenges in Columbia. Groups of five to eight people were led in discussion by a trained table host. Many members of the HIA Partner Team acted as table hosts for the discussions. After a large group discussion, the vision elements, identified challenges, and action plans were recorded on flip-charts and participants then voted using colored stickers to identify ideas they supported or felt were most important. Table hosts noted a particular topic that came up quite frequently at all four conversations was “I would like to ride the bus, but...”. Using this feedback and an interim summary report of the community conversations during the scoping phase, the Partner Team

decided to add participants who were not currently using transit services as a secondary population. This secondary population could potentially be attracted to use public transit if services were expanded.

As part of our efforts to inform decision-makers about HIA, we conducted key informant interviews with several representatives of City Government and Administration. We held conversations with the director of the Health Department, two City Council members, the City Manager and Deputy City Manager, the City Director of Sustainability, the Assistant Superintendent for Columbia Public Schools, the City Transportation Administrator, and the Director for Community Planning. During all of these conversations, we introduced the concept of HIA and promoted its utility in policy planning and decision-making. We also discussed this pilot HIA and gained insight into decision-making regarding public transit in Columbia. All these decision-makers, as well as other department heads and representatives from the public schools and other local agencies, attended a half-day workshop on HIAs, which was covered by local television and print media.

Several conversations by HIA Partner Team members were also held with key informants from either the primary HIA population or those who provided services to the primary population. Specifically, HIA Partner Team members spoke with administrators from a community health clinic, CMCA, the Health Department, Refugee and Immigration Services, and Head Start. These conversations provided qualitative data related to public transit.

Primary research collection offered an opportunity to involve stakeholders in participatory research. We engaged community members from our HIA population, low-income Columbians, to conduct a survey on the transportation disadvantaged, public transit use, and accessibility of employment and health care. The survey was developed by HIA Partner Team members and discussed with community stakeholders to ensure that the questions were clear, concise, and

appropriate (Appendix 1). Three trained community members then administered the four-page paper survey to adults at a variety of locations in Columbia, including the Social Services Administration Office, the bus depot, the Columbia Mall, the Health Department, CMCA, and MedZou, a free clinic operated by the University of Missouri School of Medicine. Community members who administered the survey received Wal-Mart gift cards, and those who took the survey had the opportunity to be entered into a drawing to win one of three gift cards. Demographic characteristics of survey participants are presented below.

Table 6: Community Survey Demographic Characteristics

Demographic Characteristics	All Respondents (n = 201)	Frequent Bus Riders (n = 131)	Infrequent Bus Riders (n = 70)
Gender	47.7% male 52.3% female	37.1% male 62.9% female	46.6% male 53.4% female
Race/ethnicity			
Black/African American	49.3%	57.3%	45.7%
White	26.5%	22.9%	38.6%
Latino	9.6%	13.0%	5.7%
Other	4.6%	4.7%	5.7%
Age, Mean (SD)	36.0 (12.0) years	35.7 (10.9) years	36.3 (13.7) years
Location of survey			
Social services	19.2%	21.4%	20.0%
Health services	18.3%	17.6%	22.9%
Downtown	11.9%	14.5%	10.0%
Library	11.0%	13.0%	8.6%
On the bus	6.8%	10.7%	1.4%
Retail	6.8%	9.2%	4.3%
School/university	9.1%	3.8%	21.4%

Data from the survey (n=201) were entered into Microsoft Excel and analyzed using SPSS. We also met with community volunteers who administered the survey to discuss the stories they heard from respondents and other anecdotes about transportation problems, accessibility, and perceptions of public transit. These qualitative data are also included in the assessment portion of our HIA.

Review of Evidence

Physical Activity

What we thought we would find:

Using public transit increases daily physical activity.

What did the literature tell us:

Studies found that transit riders spend more time walking and often walk further distances compared to car drivers, potentially meeting daily recommended physical activity guidelines. Residents of transit-oriented developments have higher amounts of overall physical activity and are more likely to meet physical activity guidelines.

Complete streets policies and public transit can potentially complement each other by providing opportunities for both physical activity and expanded range of travel.

Regular physical activity is one of the best ways to achieve and maintain a healthy life. Physical activity reduces the risk for some of the leading causes of illness in the United States such as heart disease, type II diabetes, and high blood pressure. The Centers for Disease Control and Prevention's physical activity guidelines recommends that adults ages 18 to 64 engage in 150 minutes per week of moderate-intensity or vigorous-intensity physical activity (about 20-30 minutes daily). Moderate-intensity means activity that raises heart rates, such as walking fast. Vigorous-intensity activity raises the heart and breathing rates even higher, for example jogging or swimming laps. Children and adolescents ages six to seventeen should get about an hour of physical activity each day. We will review data on how public transit use, transit-oriented development, and complete streets policies contribute to increased physical activity.

Various studies have shown that public transit can affect physical activity. One frequently cited study was conducted by Besser and Dannenberg (2005). These authors used 2001 National

Household Travel Survey (NHTS) to determine time spent walking to and from public transportation. The NHTS addresses transportation behaviors such as purpose, travel time, and mode of transportation. Besser and Dannenberg (2005) found a mean daily walking time of 24.3 minutes per person (median, 19 minutes). Individuals without a car spent more time walking (mean = 28.1 minutes) than did those with a car (mean = 19.7 minutes). Individuals without a car were nearly twice as likely to walk about 30 minutes to and from their public transit destinations (OR = 1.97, 95% CI = 1.52-2.55). The authors concluded that walking to and from public transit contributes toward achieving the recommended levels of daily physical activity. Morabia et al. found that car drivers who switched to public transportation for five days for the duration of the study burned an additional 124 calories per day (2010). In addition, participants who used public transportation five days per week, rather than driving, lost approximately one pound of body fat in six weeks. A separate study focusing on physical activity by Hill et al. (2003) estimated that expending an additional 100 calories per day could prevent weight gain in most of the U. S. population.

A built environment emphasizing public transit and active transportation, such as walking or biking, also offers greater opportunities for physical activity. Transit-oriented developments, which consist of compact, walkable, and transit-supportive environments, have been consistently associated with higher amounts of active transportation and overall physical activity. Frank et al. summarized a number of studies linking transit-oriented development to an increase in physical activity (2011). Among the key findings are that as residential density increases, body mass index (BMI) decreases. In addition, individuals living in mixed-use neighborhoods were 2.4 times more likely to meet the CDC's physical activity guidelines. Many of the vision elements voted on by participants in the PedNet Coalition's Community Conversations about Transit were votes for

improved transit-related infrastructure, including exploring transit-oriented developments in Columbia.

In 2004 Columbia became the first city in Missouri to enact a complete streets policy. Complete streets are roadways designed for use by all modes of motorized and non-motorized transportation. Common features include bike lanes, safe crosswalks, and roundabouts. These features are designed to promote more trips taken by active transportation. An assumption of complete streets policy is that active transportation and public transportation will complement each other. Individuals engaging in active transportation benefit from opportunities for physical activity as well as the increase in range by which they can travel using public transit.

In 2005, Columbia was one of four cities across the country to receive a federal non-motorized transportation grant. The purpose of the grant was to determine if investments in programs and projects related to active transportation would get more people walking and bicycling. The funds were used to build sidewalks, bicycle lanes, and pedestrian and bicycle trails that connect directly with transit stations, schools, businesses, recreation areas, and other community activity centers in Columbia. As a result of the changes made to the infrastructure, there were significant improvements in pedestrian and bicycle activity. To monitor these improvements, pedestrian and bicycle counts and surveys were performed at seven strategic locations throughout the city. In 2011, peak-hour weekday pedestrian activity increased by approximately 56% over the 2010 count, and 74% from the 2007 count. In 2011, peak-hour weekday bicycle activity increased by approximately 46% from the 2010 count, and 147% from the 2007 count.

Access to Outdoors

What we thought we would find: Use of parks and recreational areas affects health. The degree to which use of parks affects health depends on activities performed within parks and recreational areas. In addition, barriers to accessing parks and recreational areas limit the potential for positive health impacts.

What did the literature tell us: Parks and green space influence both physical and mental health. Proximity to a park or green space is associated with higher usage. Public transit could improve access for low-income populations who have limited access to parks. Columbia residents visit parks to engage in adult and youth activities, but indicated that park facilities are not close enough to their home. Many would like to see more trails and more parks in their neighborhoods.

The majority of Americans visit their local parks, with nine out of ten annually participating in an outdoor recreational activity (Cordell et al., 2004; Godbey et al., 1992, as cited in Mowen, 2010). Research has shown that living in proximity to a park or green space, generally defined as within one-half mile, is associated with greater usage, increased opportunities for physical activity, and decreased stress. Similarly, having more parks and park acreage within a community is associated with higher physical activity rates within parks among a variety of populations (Kaczynski & Henderson, 2007; Brownson et al., 1992, as cited in Mowen, 2010). Deshpande et al. (2005) reported that respondents who had used parks in the past month were more than four times more likely to have engaged in physical activity at least five times per week for more than 30 minutes per episode (as cited in Kaczynski & Henderson, 2007). The CDC recommends at least 30 minutes per day of physical activity at a moderate-intensity level, or enough to raise your heart rate. Regular exercise at a moderate-intensity level can reduce the risk for several chronic health conditions such as type II diabetes, cardiovascular disease, and some types of cancer. There may also be numerous

psychological benefits for park users that arise from being in proximity to natural environments (Bedimo-Rung et al., 2005). Park users have reported lower levels of anxiety and depression after visiting parks. Parks also facilitate social interaction, which can influence physical activity and mental health.

Transit expansion will likely impact access and exposure to park and recreation areas in Columbia. Expanding the availability of, safety of, and access to a variety of transportation options and integrating health-enhancing choices into transit policy has the potential to prevent chronic diseases (CDC, 2011). Lower income populations and some racial and ethnic minority populations have limited access to parks and recreational facilities. These disparities partially explain lower physical activity levels among these populations (Mowen, 2010). Providing greater access by improving travel connections to parks and recreational areas is one strategy to offer low socioeconomic populations opportunities for physical activity and social cohesion.

The National Recreation and Park Association recommend that a community's park system should be minimally composed of a ratio of about 6.25 to 10.5 acres of developed open space per 1,000 population. Currently, Columbia has 3,040 city-owned acres of parks and green space and 50.03 miles of trails. At about 28 acres per 1,000 people (3,040 acres/108,500 residents per 2010 census x 1,000), the city's park space to population ratio exceeds recommendations.

A 2011 survey conducted by the City of Columbia's Parks and Recreation Department found that 99% of those surveyed visited at least one city park in the past year. The three most-visited parks were Cosmo, Stephens, and Cosmo-Bethel. Forty-seven percent of survey respondents indicated that someone in the household visited the park to participate in adult or youth sports. Seventy-nine percent of survey respondents visited at least one of Columbia's trails, with the MKT Trail being the most visited. However, 24% of respondents indicated that park facilities were not close enough to their residences, while 29% responded that there were not sufficient parks and

green space within walking distance of their home. Households also indicated they would like to see more walking and biking trails and small neighborhood parks.

Access to Health Care, Employment, Education, and Healthy Food Options

Public transit currently accounts for a relatively small portion of trips in most communities, but these trips tend to be high value to users and society. Transit provides basic mobility by helping people reach important activities such as medical services, education, and employment (Litman, 2012). The decision to ride public transit is based on a complex set of circumstances, including mobility, availability of alternatives, cost of service, safety in getting from origin to bus stop and bus stop to destination, travel barriers along pedestrian paths, and other factors (Hess, 2009). Combined into this section are the identified health impacts of access to health care and social services, employment, education, and healthy food options under general mobility offered by an expanded public transportation system.

Access to Health Care Facilities

What we thought we would find: Transportation is a significant barrier to obtaining health care services for the transportation disadvantaged.

What did the literature tell us: Households that are transportation disadvantaged experience barriers to health care services. A significant number of Americans do not access health services due to transportation problems. When accessing health care, transportation barriers are nearly as significant as cost barriers. Public transit riders are more likely to be late for appointments or not keep them at all.

What our local survey found: Respondents who reported being primarily dependent on public transit were more likely than those who owned cars to miss health care appointments. Most respondents chose health care services based on proximity to the bus route.

Public transit is considered one of the most important social determinants of health. Reducing health disparities by increasing the prevention workforce's collaboration with community partners

who can influence social determinants of health is a goal of the National Prevention Strategy. The prevention workforce includes a combination of health care providers, public health workers, community health workers, and professions outside of the traditional health-related fields (National Prevention Council, 2011). This strategy was outlined in 2011 by the National Prevention Council and identified public transit as a community partner to help reduce health disparities. Although not traditionally viewed as part of the health care system, public transit provides access to medical and dental appointments, social services, and medical retail outlets such as drugstores and pharmacies.

Lack of transportation has been identified by the Institute of Medicine as a structural barrier to receiving health care, in the same class as availability of health care or organizational barriers (1993). Among the 8.4% of U.S. households without a vehicle, described by Wallace et al. as transportation disadvantaged, nearly as many described health care access issues related to transportation and time as significant barriers (14.3%) compared to those who identified cost as a barrier (18.8%) (2005). A secondary analysis of a range of relevant national surveys estimates that, each year, 3.6 million Americans do not obtain medical care because of a lack of transportation (Wallace et al., 2005). Specifically, articles identify transportation problems as a barrier to receiving prenatal care, cancer therapy, or care for chronic conditions. According to data from the 2007 BRFSS, 5.9% of Boone County residents who needed medical care did not receive it because of problems with transportation.

More specifically, lack of access to or use of public transit has been identified as a barrier to receiving care. A transit strike in Minneapolis led to a decrease in scheduled appointments (Pheley, 1999). At a Portland, Oregon community health center, 32% of clients described transportation as a barrier to receiving health care in the past year, and 40% had ever experienced transportation as a barrier. The transportation barrier most frequently identified was “public transit problem,” such as hours of operation, reach of public transit, or lack of reliability. Patients who ride public transit are

more likely to be late to appointments (Sipe et al., 2004), and asthma patients relying on public transit were less likely to return for follow-up visits (Smith et al., 2002). Lack of transportation may also lead some patients to seek care for non-emergency maladies at the emergency department, if the emergency department was the only option available when public transit was also available (Ramgaloan, 2007). Improvement in public transit access for the transportation disadvantaged has been described as a relatively inexpensive route to improving access to health care (Wallace et al., 2005).

A community-based survey of adults conducted at social service agencies, health care providers, and other locations in central Columbia found links between dependence on public transit and missed health care. Of 201 respondents, 18.3% said they “very often” and 37.0% said they “sometimes” missed health care appointments or had been unable to get the health care they need because of transportation problems. However, respondents who reported riding the bus at least once a week were more likely than those who rode the bus never or hardly ever to report having missed health care because of transportation problems ($t(199) = 5.53, p < .001$). In a regression model used to determine which variables predicted missing health care appointments, the strongest predictor of whether a family missed health care appointments was transportation problems ($\beta = 0.17, p = .01$), followed by frequency of bus travel ($\beta = 0.17, p = .04$).

Most respondents considered proximity to a bus stop when picking a doctor or other health care provider; 25.6% said they considered proximity to a bus stop “a lot” and 28.3% said “a medium amount”. Respondents who reported riding the bus at least once a week were also significantly more likely than those who rode the bus never or hardly ever to report that they considered proximity to a bus stop when selecting health care providers ($t(199) = 5.53, p < .001$).

Wallace et al. define transportation disadvantage as the lack of a car (2005). In the community survey, car ownership was linked with health care access. Those who did not own a car ($n = 144$)

were more likely than those who did own a car ($n = 57$) to report having missed health care appointments due to transportation problems ($t(199) = 6.07, p < .001$) and also to report considering proximity to a bus stop when selecting health care providers ($t(100) = 5.70, p < .001$). More specifically, the type of transportation was associated with difficulties accessing health care. Among all respondents, those who reported usually walking or biking ($n = 25$) were most likely to report missing appointments due to transportation difficulties, followed by those who usually used paratransit or the city bus ($n = 71$), those who got rides from others ($n = 48$), and finally those who drove their own car or motorcycle ($n = 56$). For respondents who walk or use the bus, a more reliable public transit system could increase access to health care facilities. Those who own a car were also more likely to have health insurance. Among those who did not own a car, 50% reported having any health insurance, and 50% did not. However, among those who did own a car, 64% reporting having health coverage.

Transportation has also been identified as a general barrier to health care in a number of broad-based studies focusing on underserved populations. Lack of access to transportation, also known as transportation disadvantage, disproportionately affects older people, those in poverty, those with less education, racial and ethnic minorities, and those from urban and rural areas compared to suburban areas (Rittner & Kirk, 1995; Wallace et al., 2005). Access to social services for vulnerable groups is also important as it improves access to health care and reduces unmet needs.

The same groups that disproportionately experience transportation disadvantage also experience multiple medical conditions at a higher rate, and thus require more care and more coordination of care (Wallace et al., 2005). In a door-to-door survey, 30% of nonelderly urban poor reported having a transportation barrier (Ahmed et al., 2001). The 2002 BRFSS survey found that nearly 1 in 10 adults age 65 and older did not obtain care because of transportation problems (Okoro, Strine, Young, & Balluz, 2005). When older adults have inadequate access to transportation, they tend to

experience lower levels of physical activity, reduced independence, and greater health risks (Hess, 2009). In the community-based survey of residents, there was not a significant difference in likelihood of missing appointments based on race or age. However, it is difficult to draw conclusions from this outcome, since respondents were relatively young (mean age = 36.01, SD = 11.96) and were likely to be consistently low income, due to efforts to sample clients of social service agencies and low-cost or free medical clinics.

In July 2011, the clinic located at the Health Department changed from appointment-based to walk-in based services. Before the change, in-depth interviews with clinic staff revealed that many patients missed scheduled appointments. In explaining why appointments were missed, patients often described difficulties with transportation. Clinic nurses reported that transportation barriers they encounter with patients are two-fold: patients must take the bus and work around its timetable or are brought to the appointment by a friend or family member. While providing services, attending nurses noted that many patients seemed to be in a rush. When asked by staff, the patients responded that the attending nurse must hurry with the appointment because they needed to catch the bus home or to another location. Other patients told staff they had a friend or family member waiting on them in a car and had to cooperate with the car owner's schedule. For patients in these situations, clinic staff said that there was a chance the patient would not be seen again.

Transportation as a barrier to care has also been identified among children. According to one survey, 4% of U.S. children were unable to access medical services due to a lack of adequate transportation (Litman, 2012). This survey, by the Children's Health Fund, also found that those who missed one appointment were also likely to miss more than one – 63% of those who missed an appointment missed two or more visits during the year. In addition, 31% of parents reported having to seek emergency care for the condition associated with the missed appointment (Grant, 2007). Studies describe transportation as a hidden barrier to child health care access and report that

transportation may be a barrier whether or not children are insured or living in poverty (Grant, 2007).

Access to Employment

What we thought we would find: Transportation is a significant barrier to accessing employment for the transportation disadvantaged.

What did the literature tell us: The most common reason for using public transit is traveling to work. Certain populations cannot access employment due to their residence or place of employment not being serviced by public transit. The density of public transit routes positively impacted employment for all income levels.

What our local survey found: A significant amount of respondents reported missing work due to transportation problems. Respondents who did not own a car and rode the bus frequently reported missing work more often than those with a car and who did not ride the bus. Most respondents considered proximity to a bus route when looking for employment.

Employment provides a vital link between the individual and society. It enables people to contribute to society and achieve personal fulfillment (Doyle et al., 2005). The type of job, wages, and the conditions to which workers are exposed also influence health and well-being. Unemployment, especially long-term, has several negative health effects such as poor living conditions, mental health effects, and increased risk of mortality. In the United States, the most common purpose for taking public transit is traveling to and from work. A 2011 study conducted by the American Public Transportation Association indicates that 59.2% of individuals surveyed used public transit to travel to work. Income and employment status determine the affordability of travel by different modes. Households with higher income are more likely to drive cars. The share of travel by car increases with both individual and household income. Those who are employed are more

likely to own cars and therefore, are more likely to drive (Bailey et al., 2008). A growing field of research focuses on how access to public transit affects employment.

One of the effects that has been studied is known as spatial mismatch. Since the end of World War II, many jobs (as well as employees) left central cities and relocated to suburbs. Employees left behind in central cities, largely racial and ethnic minorities, faced barriers getting to and from jobs located in suburbs. They were essentially cut off from employment opportunities because city public transit did not provide service to areas of employment in suburbs. If these employees lacked stable transportation, private or public, many were not considered candidates for employment. Research about spatial mismatch between living and job locations for low-income workers show that employment prospects are negatively affected by distance between a person's residence and job-rich areas (Rice, 2001). Ihlanfeldt and Young found that 35% of the central city difference in employment for African Americans is due to inaccessibility of suburban firms by the public transit system (1993). For those who are employed, transportation instability can also create problems such as absenteeism. Businesses located near public transit have better employee reliability, less absenteeism and employee turnover, and access to a large labor pool (APTA, 2010).

Rice combined three national data sources to examine the effect of public transit service density on an individual's employment outcomes while controlling for city and individual characteristics (2001). The author found that the density of public transit routes had a positive effect on employment for the population as a whole. Specifically, for every 10% increase in transit density, the probability of finding employment increased 0.3% for those with no college education. However for the higher educated population, transit density was found to have no impact on employment.

During an interview with Columbia Refugee and Immigration Services (R&I), the staff noted that transportation placed limitations on their clients' ability to search for employment. When R&I look for a new employer to work with, they often cannot work with companies in the growing areas

of Columbia if a bus route does not provide service to the location. At other times, if R&I does find an employer, they can't necessarily place the most qualified refugee in the position. Instead, they have to put priority on placing the one who has a car.

The community-based survey conducted at social service and health care agencies also asked about transportation and access to employment. Of 201 respondents, 16.4% reported missing work “very often” because of difficulties with transportation, and 40.2% reported missing work “sometimes” compared with the 17.4% who reported missing work “not very often” and then 18.7% who reported missing work “never”. Car ownership and bus ridership was also significantly associated with missing work due to transportation problems. Those who did not own a car were more likely to report missing work than those who did own a car ($t(199) = 6.21; p < .001$). The same pattern was true for those who rode the bus frequently compared with those who did not ($t(199) = 5.81, p < .001$).

In a regression model used to determine which variables predicted missing work, likelihood of picking employment based on proximity to the bus was the strongest predictor ($\beta = 0.28, p < .001$), followed by likelihood of missing health care appointments due to transportation problems ($\beta = 0.24, p = .001$), how frequently family missed work due to transportation problems ($\beta = 0.14, p = .03$), and frequency of bus travel ($\beta = 0.14, p = .09$). Those who usually relied on walking, biking, or public transit to travel more frequently reported problems with transportation than did those who usually drove their own car. Those who walked or biked were most likely to report missing work based on transportation problems (11.4%), followed by those who used paratransit or the city bus (32.4%), those who usually received rides from someone else (21.9%), and those who usually drove themselves (25.6%).

Most participants said they considered proximity to a bus station when looking for employment; 27.9% said they considered it “a lot” 26.5% said “a medium amount” 14.6% said “a little” and

22.4% said “not at all”. Participants who did not own a car were more likely to consider proximity to a bus station when looking for employment ($t(196) = 5.28, p < .001$). Participants who rode the bus were also more likely to consider proximity to a bus station ($t(197) = 4.55, p < .001$).

In in-depth interviews, community members conducting the surveys reported that respondents who depended on the bus had difficulty getting to work because of the limited hours of operation. Another barrier to employment for respondents was the long headway during mid-day hours. If a transfer was required, a trip to and from work or a job interview could take more than an hour. One volunteer described how she researched bus times for a job interview and taken the bus to a location south of town to wait for her transfer. The bus she was waiting for never came. She was so late for the interview that she ended up taking the original bus again when it passed by on its return to the station.

Access to Education

What we thought we would find: Transportation is a significant barrier to accessing educational opportunities and extracurricular activities after school.

What did the literature tell us: Increased education is related to improved health and decreased risk for all-cause mortality. Transportation is a barrier to after-school activities in that it affects who can attend, when they attend, and the costs of the activity. Safety of public transit is a concern of parents or caregivers of school-age children.

What we found during local interviews: Local Head Start locations have families who identify transportation as a significant barrier. Some children cannot participate in the program due to low attendance rates, often because they lack transportation.

Increased access to transportation can also increase access to educational opportunities. In general, increased education is related to improved physical function and self-rated health (Ross &

Wu, 1995) and decreased risk of all-cause mortality (Hadarson et al., 2001). People with greater levels of education have lower morbidity rates from most common acute and chronic diseases, independent of demographic characteristics (NPC, 2011). Specifically, these differences cannot be explained entirely by differences in health behaviors. Potential mechanisms linking lower levels of education with poorer health include the increase in resources associated with greater education, increased learning about and appreciation for health-promoting behaviors, and differences in social networks (NPC, 2011). Studies have also examined the magnitude of the relationship between educational level and disease risk. More education reduces the risk of diabetes by 1.3%, the risk of heart disease by 2.2%, and the risk of work days lost to sickness by 2.3%.

Most studies of transportation and educational access have explored the link between transportation and participation in after-school programs or extracurricular activities. After-school programs are thought to occupy youth during the times when juvenile crime peaks, from 3 p.m. to 6 p.m. (Rivera & McCorry, 2007). Large-scale studies have concluded that providing after-school activities for adolescents reduces opportunities for criminal activities or substance abuse during this critical after-school period (Rivera & McCorry, 2007). However, most after-school programs in one study reported low participation rates by low-income children, due in part to transportation difficulties as well as program costs, lack of awareness, and a lack of motivation (Partnership for Prevention, 2003). One study of after-school programs reports that, “Transportation appears to be the most complex and formidable of the challenges faced by school-based, after-school programs. It affects the hours of programming, who is able to participate, and the cost of the program. Programs’ inability to provide transportation home is a barrier to participation for a large proportion of students” (Grossman et al., 2001). Specific problems include the cost of extending school bus hours and the feasibility of walking to or from programs. Many coordinators of after-school programs who cited transportation home as a barrier to participation did not consider public transit as an option

because of concerns about safety (Grossman et al., 2001). Transportation is an identified barrier to participation in specific after-school programs as well as a cause of absenteeism among those who participate. Evaluations of why students fail to participate in after-school programs have found that between 15% and 20% cite inability to find a ride home as a reason for not attending (Gardner et al., 2009). Students who lack access to after-school programs also lack access to some of the potential benefits, such as improved academic performance, attitudes and beliefs related to academics, learning behaviors, and attendance (Gardner et al., 2009). It is possible that increased access to after-school programs could then lead to a greater chance of remaining in school or of greater academic achievement, both of which have been linked to improved health.

In Columbia, transportation is an identified barrier to consistent attendance at subsidized childhood education programs. In in-depth interviews, team leaders described transportation as a gap in service and a significant need for families. Some families struggle to get children to school because they live too far from the location to walk, gas prices are too high, or transportation is not reliable. Some families rely on others to provide rides, which is a tenuous arrangement potentially threatening the child's continued enrollment in the program. Head Start requires 85% overall attendance, and chronic absenteeism could render families ineligible for Head Start services. Although families often request transportation on their Head Start applications, that service is no longer available due to budget cuts.

Reports linking health with years of education regardless of job characteristics, income, and family background suggest that policies promoting college attendance might be particularly beneficial to promoting health (NPC, 2011). In Columbia and Boone County, using public transit to attend classes might not be possible if students attend classes during the evening hours, for example. Columbia College in central Columbia, the Career Center in south Columbia, and the Moberly Area Community College on the Business Loop offer many evening classes that do not end until 8 or

9pm, after the bus has stopped running on all days but Thursday and Friday, when the bus currently stops running at 9:15 p.m.

Access to Healthy Food Options

What we thought we would find: Accessing retail outlets that provide fresh food options is a challenge for transportation disadvantaged populations. Low-income populations suffer disproportionately from chronic health conditions that healthy eating may prevent.

What did the literature tell us: Low-income populations experience lack of healthy food options. Food asset mapping of Columbia revealed that residents of low-income households were more likely to use public transit to access a grocery store if they lived more than one mile away.

Public transit offers accessibility to retail outlets that provide healthy food options and that are not within walking distance. Healthy eating can help prevent or mitigate several chronic health conditions such as type II diabetes, hypertension, and obesity. A 2009 United States Department of Agriculture report to Congress found that some consumers have difficulty accessing grocery stores because they live far away or do not have transportation. In fact, the best documented barrier to obtaining healthy food is a lack of grocery stores, particularly in low-income neighborhoods. Shopping at grocery stores compared to convenience stores is correlated with healthier eating, including greater consumption of fruits and vegetables (RWJF, 2006). Grocery stores have lower prices than convenience stores. In Newark, New Jersey, residents saved 38% on food bills from shopping at a new grocery store (Bolen & Hecht, 2003). A lack of grocery stores is particularly prevalent in low-income and inner-city areas, such as the area including downtown Columbia. Low-income zip codes have half the square footage devoted to grocery stores as in high-income zip codes (Pothukucki, 2005).

In a report from the Robert Wood Johnson Foundation (2006), the director of the Community Food Security Coalition states that, “In many ways, food access is a transportation issue. If you have a car, there’s no problem. If you don’t have a car, you are dependent.” Recent food access mapping of Columbia suggests that for those without a personal vehicle, public transit was likely to serve as the main option to reach a food store that was greater than one mile from residence. Bus routes service the majority of low-income areas in Columbia but those who live on the boundaries of the city are not serviced. Low-income households were the highest percentage of users of public transit to access supermarkets (24.2% of total respondents) (Unite 4 Healthy Neighborhoods, 2012). In Hartford, Connecticut, a bus line was added to employment hubs and supermarkets. In the first year of operation, ridership increased by 100%, and 33% of riders used bus lines for grocery shopping (Gottlieb et al., 1996). Boulder, Colorado, also saw a ridership increase of 800% since implementing new transit routes to popular locations, such as grocery stores (RWJF, 2006). In Austin, Texas, interviews with community members lead to the creation of a popular “grocery bus” route, specifically designed to provide access to supermarkets for 23,000 residents of the city’s east side (Gottlieb et al., 1996).

Creation of a Livable and Sustainable Community

What we thought we would find: Crime, or the perception of crime, would influence public transit ridership.

What did the literature tell us: Public transit systems operate within society, so they are affected by the same problems that are found in society. Built environment characteristics, such as the surrounding area where bus stops are located, or the condition of the bus stops themselves, are variables which are associated with higher crime rates. Improving conditions surrounding bus stops, or moving stops to more desirable locations could help lower transit crime. Exploring transit-oriented developments and repairing existing infrastructure that allows for a mix of walking, active transportation, traffic calming measures, and public transit could improve social capital and keep more eyes on the street. Social capital has been linked with lower rates of morbidity and mortality.

A variable that could potentially influence public transit ridership is actual or perceived crime and safety. Beginning in the 1960s, researchers have studied the link between the physical environment and crime. Greenberg and Rohe (1984) note that the design and layout of the built environment can affect crime by allowing access for perpetrators, ease of entry and exit, and surveillability (as cited in Liggett et al., 2004). In addition, neighborhood characteristics can influence crime rates. For example, abandoned buildings, vacant lots, and presence of liquor stores are more likely to generate crime. Public transit crime is not an independent phenomenon, but is a variant of societal crime. Public transit systems naturally operate within the confines of society so they often prosper from the same amenities and suffer the same shortcomings. Since crime is pervasive in society, it could also be a public transit problem (Federal Transit Administration, 1997).

Additional characteristics of the built environment that influence public transit usage include lighting and maintenance of sidewalks and streets. However, environments that pedestrians perceive as having “physical and social disorder” such as real or perceived crime, litter, graffiti, and abandoned buildings negatively influence use of transportation modes (Loukaitou-Sideris, 2004). One strategy to address the effect of the built environment on crime is known as Crime Prevention Through Environmental Design (CPTED). CPTED is based on the theory that improving the design and effective use of the built environment can reduce the incidence of crime by taking into account environmental conditions and the opportunities they offer crime or other undesirable behaviors. Examples of CPTED include installing traffic calming measures to discourage cut-through traffic or maintaining landscape features that reduce blind spots within neighborhoods.

The location of bus stops within the built environment influences transit crime. Liggett et al. (2004) gathered data on three groups of physical conditions surrounding public transit sites: urban form characteristics, bus stop characteristics, and street characteristics (2004). Urban form characteristics include land use, the condition of the surrounding neighborhood, and the concentration of undesirable places (such as bars and liquor stores). Bus stop characteristics include the layout, visibility, and lighting. Finally, street characteristics include pedestrian and traffic levels. The authors discovered that crime rates were higher at bus stops located near undesirable locations such as alleys, vacant buildings, and check-cashing establishments. Stops located near alleys and check-cashing locations showed the strongest positive correlation with crime rates. That is, at stops located near these locations, crime rates were higher. Some environmental variables the authors found to negatively influence crime rates include good visibility, higher levels of street traffic, and high pedestrian presence.

Table 7: Environmental Variables Related to Bus Stop Crime

Variables Associated with Higher Crime Rates	Variables Associated with Lower Crime Rates
<ul style="list-style-type: none"> • Liquor stores and other undesirable Establishments • Vacant Buildings and Lots • Rundown Buildings • Level of Litter 	<ul style="list-style-type: none"> • Large/Closed Front Commercial Buildings • Visibility • Bus Shelters • Street Traffic • Pedestrian Presence

Liggett et al. (2004)

During the Community Conversations about Transit, many votes were cast in favor of education campaigns. One of the reoccurring themes was to create a campaign to change the perception of public transit, specifically with regards to safety. Many participants felt that the community as whole perceived city buses as unsafe. In turn, this perception leads to the view that the bus system is not a useable mode of transportation. Columbia Transit data over a three-and-a-half-year period, from 2008 through the middle of 2011, show a decrease in police calls to Wabash Station. Over that period a total of 242 calls were placed. The most common calls were “check subject” (n = 61) and “trespassing” (n = 23). Check subject calls can be anything from a medical emergency to a report of a suspicious person. Transit staff indicate that a high number of check subject calls are medical related.

Columbia Transit takes a number of environmental variables related to bus stop crime into consideration. Wabash Station is well lit and has heavy pedestrian presence and street traffic. Bus drivers receive training for procedures when encountering disruptive riders. City buses are equipped with audio and video surveillance. Bus drivers note that the most common crime encountered in the field is vandalism of bus shelters. Community volunteers administering the survey also noted that respondents who rode the bus mentioned feeling unsafe when adolescents who boarded the bus after school were rowdy or disrespectful.

In 2011, the City of Columbia conducted its fourth DirectionFinder survey. The survey measured citizen satisfaction for a number of major city services such as utility services, stormwater management, and customer service quality. A total sample size of 834 households was obtained. Respondents identified that maintaining city streets and infrastructure and protecting residents and businesses from crime should be major community priorities. In our survey, 26.7% of frequent bus riders and 20.0% of infrequent bus riders selected “safer buses” as one of the top-three improvements they would like to see made to the bus system.

Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society’s social interactions (The World Bank, 2012). Identified health benefits linked to social capital include prolonged life (mortality), better health overall (morbidity), cardiovascular health, faster recovery from illness, improved mental health, and a number of other benefits (Ewing et al., 2006). Public transit can provide opportunities to support social capital. Previously mentioned in the physical activity section, transit-orientated developments consist of a compact, walkable environment that supports public transit. Leyden (2003) discovered that respondents of a survey conducted in Galway, Ireland who lived in the walkable, mixed-use part of the city scored higher on all measures of social capital compared to residents living in less pedestrian and mixed use areas of the city (OR = 1.80-1.95). A similar study was performed in two Portland, Oregon, neighborhoods. While demographics and attitudes toward public transit were similar, one neighborhood followed traditional land-use patterns while the other had large lots and wide streets. The study found that the strongest predictors of a sense of community were having positive attitudes toward walking, the perception of opportunities for social interaction, and having a safe and interesting walking environment (Ewing et al., 2006).

Next Steps

In accordance with HIA best practices, the Health Department staff will be conducting both process and impact evaluations of the HIA. The process evaluation will address steps within the HIA framework for the HIA Partner Team to improve upon and include when conducting future HIAs. The impact evaluation will monitor the implementation of recommendations made in the report.

Communicating the findings of the HIA will be performed in a number of ways. Full reports and executive summaries of the HIA will be provided to stakeholders. Copies of the full report and executive summary will be made available on the Columbia/Boone County Department of Public Health and Human Services website. Presentations of the findings will be made to the Board of Health and the Columbia City Council.

Limitations

The biggest limitation encountered was developing capacity to conduct an HIA. Prior to the Columbia Transit HIA, no member of the HIA Partner Team had conducted or been a part of a Health Impact Assessment. To develop capacity, the HIA Coordinator attended trainings and the team as a whole received technical assistance throughout the project timeframe. Developed HIA practice standards were used as guidance, but as this is the team's first HIA, not all elements were able to be included.

The scope of the HIA also changed during the project timeframe. Originally, the scope of the HIA was to examine health impacts of different public transit funding mechanisms. However, discussions had not developed to the point where there was a specific funding mechanism that could be informed by an HIA. Therefore, the scope of the HIA changed to examine the community health impacts of an expanded public transit system.

Staff time was a slight limitation during the HIA. Dedicated staff time toward the project was approximately 1.25 FTE. As a result, staff was limited in the amount of primary data that could be collected during the assessment phase. Although a community-based survey with a convenience sample of Columbia residents was conducted, limited staff and financial resources existed necessary to conduct a large-scale representative survey of either population studied in this HIA, low-income Columbians or potential public transit users.

Conclusion

Overall, the evidence-base and data collection discovered positive health impacts that are linked with expanded public transit services. The identified health impacts are likely to occur if public transit expansion occurs. However, in some instances the magnitude and distribution of the impacts will potentially be correlated with the magnitude of expansion. At this point it is difficult to determine the magnitude that public transit will be expanded in Columbia, such as designing new routes or increasing bus frequency.

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Appendix 1: Community Survey

Health Department Transportation Survey

*****Fill out the survey and be entered to win one of three \$50 Wal-Mart gift cards*****

Your answers will help us understand transportation needs in our community.

The survey is anonymous. We will not use your name or address, we will not contact you about your answers, and we will not share your answers with anyone.

1. How did you get to this location today (circle one answer)?
 - a. Drove yourself
 - b. Someone else drove you
 - c. City bus
 - d. Paratransit
 - e. Walk/bike
 - f. Other _____

2. How do you usually get around (circle one answer)?
 - a. Your own car or motorcycle
 - b. Someone else drives you
 - c. City bus
 - d. Paratransit
 - e. Walk/bike
 - f. Other _____

3. How often have you missed a doctor's appointment or been unable to get the health care you need because of problems with transportation (circle one answer)?
 - a. Very often
 - b. Sometimes
 - c. Not very often
 - d. Never
4. When you pick doctors, dentists, or hospitals, how much does it matter if they are close to a bus stop (circle one answer)?
 - a. A lot
 - b. A medium amount
 - c. A little
 - d. Not at all
5. How often have you missed work or a job interview because of problems with transportation (circle one answer)?
 - a. Very often
 - b. Sometimes
 - c. Not very often
 - d. Never
6. When you look for jobs, how much does it matter if they are close to a bus stop (circle one answer)?
 - a. A lot
 - b. A medium amount
 - c. A little
 - d. Not at all

7. How often do you take the bus?
- Never
 - Once a month or less
 - Once a week
 - Several times a week
 - At least once a day
8. Please circle your three (3) favorite ways the Columbia bus service could be better.
- Buses that come more often
 - Buses that run earlier in the morning
 - Buses that run later in the evening
 - Buses that run on Sundays
 - Buses with cheaper tickets
 - Buses that go more places
 - Buses that are safer
 - Buses with shorter routes so I get there faster
9. Do you own a car (circle one)?
- Yes
 - No
10. Do you have health insurance (circle one)?
- Yes
 - No

11. How often are friends and family members unable to get health care because of problems with transportation (circle one)?

- a. Very often
- b. Sometimes
- c. Not very often
- d. Never

12. How often are friends or family members unable to get to work because of problems with transportation (circle one)?

- a. Very often
- b. Sometimes
- c. Not very often
- d. Never

13. What is your gender (circle one)?

- a. Male
- b. Female

14. What is your race (circle as many as you want)?

- a. White
- b. Black or African American
- c. Hispanic or Latino
- d. Asian
- e. Native American,
- f. Other _____

15. What year were you born? _____