Transit and Health Expert Panel

Dr. Lawrence Frank & Dr. Andy Hong

April 26, 2018

**ABSTRACT**

On March 6\(^{th}\), 2018, 12 researchers from across North America were brought together to form an expert panel focus group on the causal relationship between rail transit investment, health, and other related topics. Findings of the panel discussion are grouped into three sections: (I) What to study; (II) Who to study; and, (III) How to study. The discussion in the first section is divided into subjects related to a topic, and subjects related to gaps and opportunities in research methodology. In terms of topics, the main themes were: health, equity, new transportation technology, and economic development. The main gaps and opportunities identified were in areas of co-investments, co-exposures, and control group selection. In the second section, the main themes were vulnerable populations (physical and economic), easiest to study populations (commuters and fare card users), and populations who can provide the most insight (choice riders and small business owners around transit). Finally, in the third section, the main themes were in regard to recruitment methodology, data collection, study design, and transferability of findings. These findings are to bolster an existing literature review to help guide future research.

1. INTRODUCTION

An expert panel of researchers was convened in the form of a focus group discussion as part of a larger project, funded by the Vancouver Coastal Health Authority, City of Vancouver, and TransLink, to conduct a literature review on the results and methods used in previous studies of the health impacts of fixed guideway transit investments. This very timely review was stimulated by the Millennium Line Broadway Extension (MLBE). When completed, the MLBE will run east-west through the area of Vancouver and expands on an existing rail system to the east, while connecting the University of British Columbia to the west.

In support of the MLBE investment, Danielle Devries, Meghan Winters, Mike Brauer, Andy Hong, Nicole Iroz-Elardo, and Lawrence Frank (the project’s Principal Investigator) completed a review of the causal effects of rail investment on health and provided their literature review and executive summary to the expert panelists prior to the focus group meeting. The panelists were chosen because they have or are currently conducting a pre-post assessment of the health impacts of rail investment. Research produced by these panelists was included in the literature review. For a full list of panelists, please refer to Appendix A. Dr. Hong and Dr. Frank have conducted pre-post rail studies in the USA.

The main purpose of this panel was to identify common themes and perspectives among these key researchers and to increase the overall understanding of ways to advance the state of the practice in
evaluating behavioural and exposure-based health impacts of transit investment. Vince Verlaan from MODUS consulting facilitated this panel with support from Dr. Frank’s team at the Health and Community Design Lab. Dr. Frank prepared the structure, instructions, and script (see appendix 1) for this discussion and sent it to the panelists and the facilitator prior to the meeting. This memo provides the structure for this report. The session was conducted virtually using GoToMeeting, a web-based conferencing tool. Appendix 2 is the power point slides used to convey the results from the review and Appendix 3 is the list of Expert Panel Members.

The remainder of this report is divided into sections: (1) What to study; (2) Who to study; and, (3) How to or methodological approaches to studying health impacts of fixed guideway transit investment. Each section is organized by stating the guiding questions, the main themes drawn for all of the questions, followed by an exploration of individual themes. Finally, the report concludes with a summary and closing remarks.

2. SECTION I – WHAT TO STUDY

The first discussion section was led by the following questions:

(1) What new topics of behavioral and/or exposure-based impacts of rail should be focused on in upcoming studies? This may include transportation infrastructure and services, technologies, mechanisms, or health outcomes.

(2) Where are the biggest content gaps, scientific needs, and emerging opportunities being created through new transportation services, technology, and advances in data collection methods?

The main topical themes were: health, equity, and the psychology of ridership. Secondary topics were discussed in regard to new transportation technologies, and economic development. Some of the main scientific gaps and opportunities included more accurately teasing out the impacts of co-investments and co-exposures, as well as reducing bias with control groups.

2.1. HEALTH IMPACTS

All panelists were interested in understanding the causal impact of transit on physical and mental health outcomes. However, it was acknowledged that very little research has been conducted on topics related to chronic disease endpoints. Most studies are underpowered (too small of a sample size) to effectively show significant relationships between transit investment and chronic disease. Mental health was only discussed in terms of an indirect relationship through sense of community and only one researcher had examined this relationship directly.

To further tease out health impacts, it was agreed that, where possible, researchers should specifically study sensitive populations, including elderly and youth, and use real-time objective data collection and monitoring methods to understand how environmental exposures affect behavior and health outcomes. This requires capturing time spent in specific places with varying levels of exposure to air pollution and noise and in places that support social interaction and physical activity.

2.2. EQUITY IMPACTS

The discussion around equity focused on accessibility, safety, and sense of community. In terms of accessibility, some of the key questions were:
1. How can we merge existing approaches to measuring regional transit system accessibility and link them to individual-level intervention studies?
2. How does the transit investment under investigation impact access to opportunities for captive versus choice riders?
3. To what extent are fixed guideway transit investments causing displacement of lower income populations and how can this displacement be spatially measured and tracked over time?
4. How do potential changes in air quality due to a transit investment influence lower income populations who are more likely to live along busy streets and also engage more in active travel for utilitarian purposes?

It was mentioned that in some regions, fear of crime has influenced how people perceive transit and thus affected ridership. The impacts of transit investment on actual and perceived crime levels were discussed and remain an important topic. Key questions include:

1. Under what circumstances will transit expansion increase or decrease crime levels in and around station areas?
2. How does the perception of safety and crime levels across income and age groups change after transit investments are made?

It was also mentioned that the relationship between sense of community and transit investment, or conversely, social isolation and transit investment is understudied. Some researchers are trying to capture sense of community and social isolation impacts of fixed guideway transit investments in their study designs.

2.3. PSYCHOLOGICAL PREDICTORS OF TRANSIT USE
Psychological predictors of transit use included two focus areas (1) monetary and time tradeoffs for different transit markets (captive and choice; and across income levels) when choosing to ride transit; and (2) better understanding of certain demographic groups including seniors and others with specific functional needs and their decision-making process when choosing whether or not to use transit.

There was some discussion around how other emerging transportation services such as Uber and Lyft may impact transit ridership and how that could differ across different sub-groups. When studying the impact of transit investments, it will be increasingly important to capture the role that other emerging services and technologies play in shaping travel patterns. Understanding how other services and technologies impact different demographic groups will be important. For example, seniors often rely more heavily on transit than other populations but may have some limitations in using mobile apps and other technologies required to access these services. Lower income groups may also have limited access to these services as well. Another emerging opportunity for research that was discussed was usage of massive amounts of travel data being collected through electronic fare cards like the Compass Card and other forms of cell phone technology.

Another opportunity for future research is the integration of transit with non-motorized modes of travel that work synergistically with transit to capture trip ends and ridership. Station area design could be studied based on the level of modal integration that is provided and time – transfer relationships between walk and bike and other modes serving local areas and regional accessibility on transit.
2.4. LAND USE IMPACTS AND ECONOMIC DEVELOPMENT
Panelists agreed that more time is needed to assess the impact of rail investment on land use. It was agreed that the 5 years provided for a typical longitudinal study would be insufficient to capture secondary land use impacts of transit investments and how this in turn impacts travel patterns. Some panelists were interested in exploring how different types of transit investments may or may not result in changes in land use patterns. There was some suggestion of exploring potential for economic development along major designated walking and biking routes to the transit stations. There was a broader discussion about ways to measure broader economic implications in terms of workforce productivity and shifts in time use patterns relative to the cost associated with transit investment at the corridor and regional level. This would require capturing changes in network travel times on roadways and facility performance and levels of service before and after transit investments are made.

2.5. NON-MOTORIZED INVESTMENTS
There was agreement over the need for more careful assessment (as previously noted) of improvements made to pedestrian pathways and construction of new bike paths occurring simultaneously with rail transit investment. There was a hope that advancements in new phone technology can help determine how transit itself and transit along with other modal investments impacts travel patterns and physical activity levels. The goal of this research will be to evaluate which combinations of multimodal investment that integrates transit, bike, and pedestrian infrastructure are most likely to result in the greatest increase in physical activity within different built, natural, and social environment contexts. Finally, future research should examine the cost benefit of different choice sets of investments relative to predicted health care costs and other factors.

There was agreement over the need for more careful assessment (as previously noted) of improvements made to pedestrian pathways and construction of new bike paths occurring simultaneously with rail transit investment. There was a hope that advancements in new phone technology can help determine how transit itself and transit along with other modal investments impacts travel patterns and physical activity levels. The goal of this research will be to evaluation which sets of transit, bike, and pedestrian infrastructure investments are most likely to result in the greatest increase in physical activity within different built, natural, and social environment contexts. Finally, what is the cost benefit of different choice sets of investments relative to predicted health care costs and other factors.

2.6. EXPOSURE TO AIR POLLUTION AND NOISE
As noted, panelists strongly suggested that co-exposures need to be further studied to better understand how transit impacts on behavior and air pollution impact specific chronic diseases.
Increased exposure to air pollution and noise could negate positive behavioral effects of new transit investment. Studies are needed that help determine under what conditions transit investment may reduce or increase exposure to noise, pollution and traffic related injury risk.

3. SECTION II – WHO TO STUDY

Section II was guided by the following questions:

(1) Who should future studies focus on as end-users of transit and as impacted members of society? Past studies have focused mostly on adult residents while only one study focused on employees. How can recruiting employees maximize new insights?
(2) How can studies be designed so that focusing on specific transit markets (e.g., captive and choice) and on elderly, youth, lower income, or disabled best advance the field?

In response to who to study, panelists referred to populations that fall within the following categories: (1) those who are most vulnerable; (2) those who are easiest or hardest to study; and, (3) those who can shed the light on motivations for using transit. The following sections discuss each of these categories.

3.1. VULNERABLE POPULATIONS
The panelists mentioned many different types of vulnerable populations that can be generally categorized under those who are physically vulnerable (have a chronic disease, obese, sedentary, elderly), and those who are economically vulnerable (low socio-economic status, potential to be gentrified).

3.2. VULNERABLE POPULATIONS: PHYSICAL
For the physically vulnerable population group, those who are chronically sick were highlighted with a focus toward sensitive sub-populations, such as children with asthma, adults with hypertension, or those who have mental illnesses, and those who are obese or sedentary. One panelist specifically pointed out that people who are most sedentary, or those who are least likely to walk, may be an interesting group to study because they may develop illnesses later on.

This led the conversation towards studying the impacts of transit investment on the elderly as they are particularly susceptible to adverse health effects as many preexisting diseases converge in old age. One panelist shared an insight they gained with a developer, that seniors do not need to be incentivized to move to areas around transit because these types of developments are already attractive to older adults. This adds a unique perspective when considering elderly population because those who are heavily reliant on transit are willing to relocate to accommodate their transportation needs. However, older adults are often on fixed incomes and increasingly unable to afford living near transit.

Those overweight or obese, elderly, disabled, and youth may share some similarities in terms of limited personal mobility and benefit from being closer to transit. Incentivizing any of these sensitive populations to live closer to transit could have considerable health benefits.

3.3. VULNERABLE POPULATIONS: ECONOMIC
It was agreed that economic impacts of transit investment on vulnerable populations is complex. For instance, both residents and businesses can be displaced after rail investment when land prices increase; however increased access to jobs and other opportunities can result in economic benefits to these same populations. It is unclear where and under what conditions transit investments improve employment opportunities for vulnerable populations.

3.4. POPULATIONS TO STUDY
Some populations thought to be easier to study are those who take transit regularly. In some jurisdictions youth can be included as a population to study because some schools provide students with an option to take public transit, instead of a school bus.

Other panelists were excited about recruiting employees through engagement with their employers. As opposed to an extensive body of research on residential environment, it was acknowledged that work environments were understudied. This point was well taken by the panelists because most people spend significant time in and around their work environments. Further, for both of these residential and work
environment settings, it is possible to test programmatic changes made to incentivize or popularize participating in active transportation. An example would be children biking to school on their own, or employees being engaged in bike to work week initiatives.
Lastly, all panelists expressed great interests in studying fare card users because large-scale data can be collected and analyzed through automated fare card system already in place in many transit systems. This could be linked to engaging employers who offer fare cards to their employees. One panelist suggested linking fare card with driver’s license so that other information, such as body weight, can be collected.

3.5. POPULATION OF INTEREST
Panelists identified some populations that would likely provide the greatest or most interest insight into pre-post transit investment studies and health. Studying changes in travel habits for those that work along new rail corridors was of considerable interest and is understudied to date. There was also interest in choice riders or people who shift from cars to transit.

3.6. POPULATION OF INTEREST: CHOICE RIDERS
Panelists were curious about choice riders, i.e. those who have other transportation options available to them but instead choose to use transit. Specific questions were related to choice riders who shift their behavior from Single Occupancy Vehicles (SOV) to public transit. Panelists were curious to know exactly what drives this behavior shift, as a way to potentially capitalize on it. In addition, panelists were curious about the potential health benefits of making this shift.

3.7. POPULATION OF INTEREST: SMALL BUSINESS OWNERS NEAR TRANSIT
Some panelists were interested in investigating how small businesses are impacted during transit construction or upgrading. They cited rail projects in New York City and Washington, where the news coverage is generally negative as a result of the interrupted access to businesses during construction and increased rent prices after the construction is completed. The question was whether there is a way to include a small sample of small business owners when designing a study to understand employers, or employees, and how disruption from construction could affect them.

4. SECTION III – HOW TO STUDY
Section III was guided by the following question:
(1) How, or what methods would you employ to improve upon current approaches to study design, sampling, data collection, and statistical analysis? Specifically, are there approaches you would like to employ to improve:
   a. Recruitment and data collection
   b. Spatial sampling for case control longitudinal designs
   c. Measurement of built, natural, and social environment features
   d. Reaching hard to reach households, targeting specific demographic groups
   e. Timing of baseline and follow up data collection periods to capture nearer and longer-term impacts (e.g. land use)
   f. Monetize health impacts of transit investments
   g. Address combined and separate impacts of rail and non-motorized investments
   h. Statistical and analytical methods to better isolate cause effect relationships, clustering, and address other previous limitations
Given the nature of a large group discussion, panelists were only allowed to provide brief suggestions for methodological issues in regard to the above questions. Responses are organized by recruitment, data collection, and transferability.

4.1. RECRUITMENT
First, one panelist explained tactics they have taken in the past to reach those who are typically considered to be “hard to reach populations.” Their tactic was to engage with community-based organizations that already established relationships with the community and to conduct community outreach initiatives. The panelist discussed that this tactic was a good starting point, but further efforts and innovative strategies should be needed in order to recruit “hard to reach” populations more effectively and systematically.

Second, panelist stressed many times over the duration of this focus group that people need to be studied within their workplace environment, and more effective tactics would be needed to target and recruit this specific population of interest.

Third, one panelist brought up the challenges with phone match services as a primary way to reach populations. By citing the panelist’s own experience, the panelist expressed that this service would only capture approximately one third of their sample area. To account for this limitation, they utilized a tactic of door-to-door knocking. However, they admitted that this was expensive and labor intensive. Also, it was not the most effective strategy to recruit participants. It was also noted that this door-to-door strategy comes with difficulty to reach people living in apartment buildings that have no public access.

Finally, one panelist suggested that researchers can leverage already existing baseline information gathered by other surveys in the region of interest. These existing data may have longer timelines and provide more consistent information on travel behaviour, before and after rail investment. Leveraging existing data for evaluation of transit investment has been done in some studies covered in the aforementioned literature review – these studies used cross sectional samples collected at two different time points. Researchers may also use existing data to retrospectively investigate the effects of transit interventions.

4.2. DATA COLLECTION
Questions related to data collection included “How can we develop better cell phone-based applications?” and “Better methods are needed to more accurately tease out the physical activity attributed to transit investment, and those associated with other daily activities.” Panelists were curious about how new innovative technologies may be used to reduce costs while also yielding objective data. One panelist suggested using remote sensing data, such as google maps or satellite imagery, as an area of innovation in data collection for characterizing the micro-scale condition common for active travel research. Another panelist suggested the possibility of developing micro sensors to assess how people are affected psychologically in a given geographical space.

4.3. STUDY DESIGN
In terms of study design, panelists made suggestions for length of study, buffering, and control groups. The most notable limitations included the typical five-year length of study, which is not enough to accurately determine the long-term effects of transit investment. Panelists were in agreement in that future studies may need to have longer timelines; if even by a year. As previously noted, extending study
duration is particularly important to evaluate how changes in land use along rail lines impacts travel patterns and activity levels.

One panelist suggested that the usual buffering around stations and stops needs to be expanded, especially for locations where there are higher concentrations of dependent riders because they are likely to travel further. Finally, panelists discussed ways to isolate the impacts of bike lanes and sidewalk improvement from the transit investment. It was suggested that one could use a case-control design with careful spatial sampling to compare the effect of rail investment that included non-motorized vs. another area without non-motorized investment but similar in many other ways. Alternatively, this could be done over time when rail and non-motorized investments occur incrementally. This enables studying the effects of the first investment, then studying the following investments in a chronological fashion, focusing on the accumulative or synergistic effects of multiple investments over time.

4.4. TRANSFERABILITY
Panelists discussed that regions differ considerably in their political contexts and receptivity to transit. More auto-oriented areas may not accept results from other regions that are more transit oriented and environmentally progressive. It can be challenging to convince decision makers in these regions of the health benefits of transit investments. In these areas pre-post assessment of a roads in relation to transit could be conducted to demonstrate the relative impacts of both on health. Overall, panelists agreed that more longitudinal research will be needed to ensure generalizability across regions.

5. CONCLUSION

This focus group brought together a panel of expert researchers on the subject of the causal impacts of transit investments on health. This is a relatively new research topic and much needed area of study in times of changing technologies, transportation services, and shifting demand for more transit-oriented environments. Particular areas of studies include understanding vulnerable populations, new transportation technologies, and economic development surrounding transit. Also, more research is needed to refine study methodologies to further tease out the relationships between co-investments, co-exposures, and geographic contexts. Future studies should be able to build on previous research, but more innovations would be needed in areas, such as spatially targeted recruitment, control group selection, and electronic forms of automated data collection.

Many of the panel members know each other and already work together on several of the existing studies. This conversation builds on previous discussions facilitated through the National Institutes of Health who have funded most of the studies to date in the USA. Nearly all of the panelists were from the USA due to the fact that most work on this topic to date has been completed in the U.S. Researchers indicated the desire to continue to build on this conversation and to further collaborate to better study the complexities surrounding the interdisciplinary nature of linking transit and health. To support such an endeavor, contextual differences need to be identified and studied in contrasting regions and on a range of different types of transit improvements. Efforts will be undertaken through follow up efforts to combine existing datasets in several regions where research has been done to further facilitate the ability to address complex questions and increase the transferability of knowledge across studies and regions.
Appendix 1: Expert Panel Members

The panel consisted of 11 experts in urban planning, transportation, public health, geography psychology, sociology, and criminology. Vince Verlaan served as a moderator of the meeting. Marjan Navab-Tehrani took notes and handled technical aspects of the focus group meeting. The panel included the following experts:

**Lawrence D. Frank, Ph.D. – Project Principal Investigator**
Professor and Director
Health and Community Design Lab
School of Population and Public Health
School of Community and Regional Planning
University of British Columbia

**Michael Brauer, Sc.D.**
Professor
Occupational and Environmental Health Division
School of Population and Public Health
University of British Columbia

**Andy Hong, Ph.D.**
Postdoctoral Research and Teaching Fellow
Health and Community Design Lab
School of Population and Public Health
University of British Columbia

**Nicole Iroz-Elardo, Ph.D.**
Research Assistant Professor
School of Landscape Architecture and Planning
University of Arizona

**Stephen P. Fortmann, M.D.**
Senior Investigator, Assistant Program Director, Medical Director
Center for Health Research
Kaiser Permanente

**John MacDonald, Ph.D.**
Professor of Criminology and Sociology
Department of Criminology
University of Pennsylvania

**Barbara Brown, Ph.D.**
Professor
Department of Family and Consumer Studies
College of Social & Behavioral Science
University of Utah
**Brian Saelens, Ph.D.**
Professor of Pediatrics
Professor of Psychiatry & Behavioral Sciences
Seattle Children’s Hospital
University of Washington

**Casey Durand, Ph.D.**
Assistant Professor
School of Public Health
University of Texas, Houston

**Calvin Tribby, Ph.D.**
Cancer Prevention Fellow
Division of Cancer Prevention
National Cancer Institute
U.S. Department of Health and Human Services

**Danielle DeVries, B.S.**
Research Assistant
Faculty of Health Sciences
Simon Fraser University
EXPERT PANEL: The Health Impacts of Fixed-Guideway Transit Investment Study

March 6, 2018

Agenda

- Overview (11:00 - 11:05)
- Section I - Introduction and Process (11:05 - 11:15)
- Section II - WHAT TO STUDY (11:15 - 11:45)
- Section III - WHO TO STUDY (11:45 - 12:00)
- Section IV - HOW TO STUDY (12:00 - 12:45)
- Section V - Summary & Next Steps (12:45 - 01:00)
• This study provides a review of methods and findings from peer reviewed published pre-post evaluations of fixed guideway transit investment.
• It assesses strengths, weaknesses, and gaps in the evidence base and applicability to the study of the Millennium Line Broadway Extension (MLBE).

• Pulled information from the articles
• 52 item table
• Information includes:
  • Paper details
  • Location
  • Study design
  • Type of rapid transit
  • Main outcomes
  • Study groups

• Recruitment
• Data collection
• Time lines
• Spatial scale
• Statistical methods
• Findings
General Findings in Summary Table

- Only half included a comparison group
- About 1/3 cities from the global south
- Only 12 considered vulnerable populations
- Only 7 considered employees instead of residents
- About 2/3 used secondary data
- Sample size and units varied from 10 road segments to over 22,000 census blocks
- Duration ranged from 1 to 26 years (mean 6.5 years)
- Half looked at impacts within 800m or less of stations

Section II - WHAT TO STUDY

- **What** new topics (may include transportation infrastructure and services, technologies, mechanisms, or health outcomes) of behavioral and/or exposure-based impacts of rail should be focused on in upcoming studies?

- **Where** are the biggest content gaps, scientific needs, and emerging opportunities being created through new transportation services, technology, and advances in data collection methods?
Section III - WHO TO STUDY

• **Who** should future studies focus on as end-users of transit and as impacted members of society?
• Past studies have focused mostly on adult residents while only one study focused on employees.
• How can recruiting employees maximize new insights?
• How can studies be designed so that focusing on specific transit markets (e.g. captive and choice) and on elderly, youth, lower income, or disabled best advance the field?

Section IV - HOW TO STUDY

• **How**, or what methods would you employ to improve upon current approaches to study design, sampling, data collection, and statistical analysis? Specifically, are there approaches you would like to employ to improve:
  • Recruitment and data collection
  • Spatial sampling for case control longitudinal designs
  • Measurement of built, natural, and social environment features
Section IV - HOW TO STUDY (cont’d)

- Reaching hard to reach households, targeting specific demographic groups
- Timing of baseline and follow up data collection periods to capture nearer and longer-term impacts (e.g. land use)
- Monetize health impacts of transit investments
- Address combined and separate impacts of rail and non-motorized investments
- Statistical and analytical methods to better isolate cause effect relationships, clustering, and address other previous limitations

Section V - Summary & Next Steps

- Let’s summarize the input received in the three sections we have discussed
- Summary of Key Points from the What, Who, and How discussion (4 min each with opportunity for short feedback)