

# **Master's Project: Adapting Metro Vancouver's Transportation System to be Senior- Friendly**

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## **Executive Summary**

### **Objectives**

The objective of this project is to determine ways in which Metro Vancouver's transportation system can be adapted to be senior-friendly. Metro Vancouver is experiencing an aging population and will need a transportation system which addresses this (Canada, 2017; Turcotte, 2012). A lack of options to get around has multiple implications for seniors, including isolation, declines in physical and mental health, and a risk of driving beyond ability (Munro, 2016). To address social isolation in seniors, Seniors on the Move was developed, one of four projects within Allies in Aging, a three year federally-funded Collective Impact project in Metro Vancouver (Williams, 2016a). The author of this paper is coordinating Seniors on the Move.

### **Methodology**

This paper utilizes both qualitative and quantitative data. Qualitative data is used in the form of focus groups results from seniors' experiences with transportation in Metro Vancouver, and through digital storytelling from videos produced by South Vancouver Neighbourhood House. Quantitative and qualitative data is used throughout the literature review, which pulls from the fields primarily of geography, gerontology, and population health. The literature review begins with the current ways seniors get around, and then is broken down into each mode of transportation and how each can be better suited for the needs of seniors. A systems analysis is

used to look not only at the parts of the system, but how they interact and might be changed (P. Morgan, 2005). Meadows (1999) leverage points are used to analyze where the most effort should be placed on changing the system, and how hard it will be, applied to the context of the Metro Vancouver transportation system. Final recommendations are then made using this analysis, including the identification of stakeholders who may need to be involved.

## **Themes**

The results from the literature review, the findings from the Seniors Advisory Committee of Seniors on the Move, and from the digital storytelling from seniors at South Vancouver Neighbourhood House, was grouped within the 5 A's of senior-friendly transportation, availability, acceptability, accessibility, adaptability and affordability (The Beverly Foundation Legacy, n.d.).

## **Strategic Analysis**

Using Meadows (1999) paper on leverage points to analyze which parts of the system can be changed to have the greatest impact, changing numbers through taxes or subsidies, such as eliminating fares for seniors on public transit, can be seen to have little impact. Likewise, adding capacity to increase reliability and flexibility of HandyDART, public transit, volunteer ride programs and taxis, will be helpful, but not the most effective for the cost involved. Improving

the built environment and not adding capacity for more cars can change the structure of cities, the 10th leverage point. Decreasing the delay in feedback by building now for an aging population will be effective at leverage point nine, but hard to do. Using negative feedback by increasing the cost of driving and taking space away from cars is feasible and will make other options more attractive. Creating positive feedback to increase acceptance of sustainable transportation through increasing the senior-friendliness of public transit, walking and cycling is leverage point seven, effective and feasible. The sixth leverage point is increasing information flows about transportation to the public and between policy-makers and stakeholders and is feasible. Changing the rules of the system by giving people walking, cycling and taking transit the right of way over those driving, will be necessary and effective at leverage point five. Likewise, leverage point four is changing the structure of the system to prioritize people walking, cycling and taking transit, which will be effective and somewhat feasible. The third leverage point, changing the goals of the system to focus less on getting people to work by car, will be hard to achieve, but very effective to making Metro Vancouver's transportation system senior-friendly. The most effective leverage point for the purposes of this paper, a paradigm shift, will also be the hardest to achieve in the time frame required.

## **Recommendations**

1. Continue developing and expand transit training to reach more seniors

2. Increase coordination and information flows between all transportation stakeholders and decision-makers
3. Require taxi and ride-sourcing companies (when regulated) to have a greater percentage of accessible vehicles on the road at one time to increase their availability and implement a tax on all trips
4. Increase availability of volunteer ride programs
5. Implement more senior-friendly shuttles to bridge the gap between HandyDART and conventional transit
6. Change the process of Driver Medical Exams for those over the age of 80
7. Adapt the built environment to be senior-friendly
8. Implement graduated de-licensing, based on ability
9. Increase integrated, senior-friendly land use and transportation planning
10. Change the rules of the road to prioritize vulnerable road users

## **1.0 Introduction**

This section will frame the problem definition, the structure of the report, introduce the project client and provide background and context for the project.

### **1.1 Problem Definition**

Like most of North America, Metro Vancouver is experiencing a demographic shift towards a rapidly aging population (Canada, 2017). Also, like most of North America, Metro Vancouver's transportation system was primarily built around the car, paired with low-density suburbs (Turcotte, 2012). This has had multiple, lasting, implications for transportation, as well as the health sector, housing, and environment (AARP, 2017). Transportation is often cited as the number one problem affecting seniors in the region (Saltman, 2011). Luckily, Metro Vancouver has a head start when it comes to alternative transportation options, thanks to a fully accessible public transportation system (Accessible Transit, n.d.), a developed paratransit system (HandyDART, n.d.), a network of volunteer ride programs (Available Ride Programs, n.d.), many walkable communities (Vancouver neighborhoods on Walk Score, n.d.; Winters, Voss, et al., 2015), and the beginnings of bicycling infrastructure for all ages and abilities (City projects to improve our cycling network, 2017; Surrey Councillors approve new bike infrastructure in City Centre, 2017). Thus, there is an opportunity for the region to build upon this strong foundation and simultaneously meet the social, economic and environmental goals of a Livable

Region, the region's growth strategy (Metro Vancouver, 2011), its transportation plan (TransLink, 2008) and various municipalities' transportation plans.

Currently, there are an estimated 409,929 seniors (defined as 65 years and over in this paper, unless otherwise stated) in Metro Vancouver, representing 15.8% of the total population of the region (Population Estimates, British Columbia and Sub-Provincial, n.d.). In eleven years, by 2029, Metro Vancouver will be a "super-aged" society, exceeding the threshold of 21% seniors (AARP, 2017, Population Projections, British Columbia and Sub-Provincial, n.d.). By 2041, it is estimated that there will be 853,930 seniors, making up 24.8% of the region's population (Population Estimates, British Columbia and Sub-Provincial, n.d.). While nearly a quarter of the population will be past the age of retirement (Retirement - Province of British Columbia, n.d.), they will still need to get around. The 2009 US based National Household Travel Survey found that 21% of seniors do not drive, and of seniors who had not gotten out of the house in the prior week, over half of them wanted to get out more (TransitCenter, 2016).

Whether it's planned for or not, the average male will outlive his driver's license by seven years (Foley, Heimovitz, Guralnik, & Brock, 2002). For females it is even more pronounced, at ten years (Foley et al., 2002). When this happens, seniors who have driven most of their lives to get around will find themselves relying on the following options to get around: rides from friends and family, public or paratransit, private transportation services, volunteer ride

programs or walking for short distances (Dobbs, Pidborochynski, & Tassone, 2012; Turcotte, 2012). Besides walking, all of these modes require dependence on others, and thus the cessation of driving can be perceived as a loss of freedom (Dobbs et al., 2012). Further, the policy of “aging in place” encourages a rapidly growing number of seniors to stay in their homes as long as possible, adding to the transportation burden for those who live in car dependent communities (Hill, 2010). A single panacea will not be the answer to keeping seniors moving; a continuum of options will need to be available to meet the needs of a diverse population of seniors whose abilities will change over time (Munro, 2016). This system of options will need to meet the 5 A’s of seniors transportation as developed by the now-defunct Beverly Foundation: availability, acceptability, accessibility, adaptability, and affordability (The Beverly Foundation, 2008). These criteria are often used as a standard to evaluate the senior-friendliness of one-on-one transportation options, but provide a lens in which to view the overall transportation system from a senior’s lens.

## **1.2 Structure of the Report**

This report is structured by sections. First, the organization for which this project was conducted is described, followed by background information on how this project came to be. Next, the methodology and methods used are described. The limitations of the report are then discussed. This is followed by the literature review, which begins by looking at the current and

projected travel patterns of seniors, and is followed by an exploration of each relevant mode of transportation as well as the topic of age-friendly communities. The findings from focus groups of seniors from different regions in Metro Vancouver, as part of Seniors on the Move are then reviewed, followed by findings from the South Vancouver Neighbourhood House digital storytelling project focusing on transportation. Themes and suggested solutions which run through these findings and the literature review are then highlighted within the context of the 5 A's of senior-friendly transportation as established by the now-defunct Beverly Foundation: availability, acceptability, accessibility, adaptability, and affordability.

Next, the concept of systems thinking and how it applies to this project is explored, and Meadows (1999) leverage points are introduced as ways to change how a system functions. Each of the twelve leverage points are examined to see how they can illuminate priorities in making changes in Metro Vancouver's transportation system, and where interventions will not be as effective. Finally, this analysis is used to make recommendations and identify stakeholders who will need to take responsibility for enacting them, followed by a conclusion.

### **1.3 Project Client**

Better Environmentally Sound Transportation (BEST) is a small, non-profit organization which has been promoting sustainable forms of transportation since 1991. BEST primarily operates in Metro Vancouver but has programming in other areas of British Columbia. BEST

offers initiatives, programs and services to enable people to choose sustainable and active transportation. BEST currently operates five programs: The Bicycle Valet, Parkbus BC, Living Streets, BC Commuter Challenge, and Seniors Transportation Access and Resources (STAR) (About, n.d.). BEST has worked on transportation issues related to seniors since 2011, and since 2016, has been coordinating a three-year Collective Impact project focused on reducing seniors' isolation by increasing and improving transportation options, called Seniors on the Move (Seniors on the Move, n.d.). This research project aligns with the goals of Seniors on the Move and BEST, by asking how Metro Vancouver's transportation system can become age and environmentally-friendly<sup>1</sup>.

#### **1.4 Background and Context**

Recognizing the problem of having an aging population used to getting around primarily by driving, and a transportation system not presenting appropriate alternative transportation options to driving (Turcotte, 2012), in 2010 BEST began a program called Seniors Transportation Access and Resources (STAR) (Our Story, n.d.). Funded for three years by the United Way of the Lower Mainland and the Vancouver Foundation, STAR staff worked with seniors' agencies throughout BC to improve of their seniors' transportation services (Social Planning and Research Council of BC, 2015). These services included shuttles and volunteer

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<sup>1</sup> This project is solely my opinion and does not necessarily reflect the opinions of BEST or members of Seniors on the Move.

driver programs, which offer one-on-one car transportation for seniors through the utilization of volunteer drivers (United Way, 2016). In 2013 the United Way's Better at Home program began providing funding to seniors agencies to implement or expand many of these services (United Way, 2016). In July of 2015 a call for collective impact projects combating seniors' isolation by the Federal Government's New Horizons program led to multiple senior-serving agencies across Metro Vancouver coming together and successfully applying for the umbrella project Allies in Aging (Quennville, 2016). BEST was hired to coordinate Seniors on the Move from April 2016-April 2019, one of four projects of Allies in Aging (Williams, 2016a).

Seniors on the Move is comprised of three layers. The first layer consists of four non-profit senior-serving agencies throughout the region, Burnaby Community Services, Collingwood Neighbourhood House, Share Family Services, and Silver Harbour Seniors Activity Centre, who act as implementation partners. Burnaby Community Services serves as the Project Lead. The second layer is the Steering Committee, which meets monthly and is responsible for using its collective expertise to direct the project, as well as forming working groups to tackle additional projects. As of May 2018, the Steering Committee is comprised of 20 organizational seniors and transportation stakeholders across the region. Finally, Seniors on the Move is guided by the Seniors Advisory Committee which meets quarterly and is made up of seniors across Metro Vancouver representing the project target populations: seniors 75+, with a disability, and

English as a second language (Williams, 2016a). Working with a Master's of Health Promotion class at Simon Fraser University, the Seniors Advisory Committee participated in focus groups exploring potential barriers and needs of transportation. Using human-centred design, an approach which puts the end user at the heart of any solutions (Design Kit, n.d.), the class broke into groups and came up with multiple prototype solutions (Williams, 2016b). Since the initial Seniors Advisory Committee meeting, focus groups have continued to be used to provide feedback on many of these solutions and others (Williams, 2017).

## **2.0 Methodology**

For this project a mixed methods approach was taken, using both qualitative and quantitative data. Qualitative data was extremely important to understand seniors' lived experiences and perceptions of transportation, specifically in Metro Vancouver, while quantitative data was necessary to understand the prevalence of these realities. Best practices and innovative ideas, both local and from other cities, were analyzed to address gaps in transportation options for seniors. A systems thinking approach was then used to better understand how different policies, services and infrastructure interact to form Metro Vancouver's transportation system and how this is experienced by seniors (P. Morgan, 2005). Finally, Meadows' (1999) leverage points, or places to most effectively intervene in a system, was used to identify where changes in the system might make the biggest difference for seniors.

### **3.0 Methods**

First, a literature review was conducted, with relevant findings of each mode of transportation as it relates to seniors presented. In order to do this, Google Scholar and the University of Victoria Commons Online Search was used, searching for the topics of travel patterns of seniors, driving cessation, public transportation, cycling, walking, volunteer ride programs, senior-friendly shuttles, taxis and ride-hailing, ride-sourcing, scooters and mobility devices, and ride-sharing, using a total of 66 search terms. In addition, a Google search was conducted for articles related to more community-driven approaches to seniors' transportation solutions. Non-profit resources the author was previously aware of were also used. Finally, a review of travel surveys and statistics was undertaken to shed light on the local seniors' population of Metro Vancouver and their current and projected travel patterns, including the quantitative results of the public report on the state of HandyDART in BC (Seniors Advocate of BC, 2017).

Next, feedback from seniors themselves through the findings of focus groups from the Seniors Advisory Committee of Seniors on the Move is presented, along with the solutions suggested by Masters of Health Promotion students at Simon Fraser University. The focus group notes were analyzed by compiling all of the focus group notes, with responses grouped into

different modes of transportation, and then highlighting where similar comments were made across groups, as well as when a particular comment stood out. Comments which reflect similar findings from the literature review were noted, along with comments which contradict previous literature. Next, some of the negatives and positives surrounding transportation for seniors in the digital storytelling project from the South Vancouver Neighbourhood House are explored. These sources were used because they provide insight into the recent lived experiences of seniors using Metro Vancouver's transportation system. They also highlight how individuals rely on many modes to get around, and how the different parts of the system combine to present both barriers and opportunities for seniors. The proposed solutions presented in the literature review were combined with the ideas generated by the Masters of Health Promotion students and from the Seniors on the Move Steering Committee in order to make recommendations. Each of the recommendations' feasibility and effectiveness were then examined through Meadows (1999) leverage points.

#### **4.0 Limitations**

This report will potentially lack teeth. While recommendations to improve and increase the transportation options for seniors in Metro Vancouver are made and the stakeholders needed to implement them are identified, it is far from assured that the respective agencies will act on

these recommendations. Hopefully the strength of being housed within BEST and connected to Seniors on the Move will strengthen its impact. Another limitation will be a lack of exploration of technical feasibility of some recommended transportation improvements such as specific bus routing. The report will only briefly include potential implications for the introduction of self-driving vehicles to the region, as there are too many unknowns about the topic (Neil, 2015; Wheeland, 2016). Due to the large scope of the project, some topics are not explored as much as reports focusing on one mode of transportation might do. Finally, it should also be noted that because this report was conducted for BEST, the solutions need to be environmentally, socially and economically viable, as well as senior-friendly.

## **5.0 Literature Review**

The goals of this section are twofold. First, the literature review will seek to establish evidence of the scale of the problem definition of an aging population combined with a transportation system and region designed for drivers. Second, the literature review will seek to find evidence of opportunities that might help seniors get around when applied to the Metro Vancouver context. These opportunities will need to be part of a system which meets the 5 A's of seniors transportation: availability, acceptability, accessibility, adaptability, and affordability (The Beverly Foundation, 2008). Availability refers to a system which is available when seniors want transportation, including evenings and weekends. Acceptability includes senior-friendly drivers,

limited wait times, and allowance for scheduling in advance or more spontaneous trips (Dobbs, 2012). Accessibility means transportation which goes to where seniors want to go, and offers the appropriate support necessary, such as help to the door. Adaptability refers to a system which allows for multiple destinations, can accommodate wheelchairs and walkers, and includes of both fixed routes and flexible services. Finally, affordability means that the transportation system is affordable to seniors, with subsidies in place if necessary (Dobbs, 2012).

## **5.1 Findings**

### **5.1.1 Travel Patterns of Seniors**

First, it is necessary to mention that seniors are not a homogenous group. Significant differences of transportation needs will exist depending on gender, age, geographic location, and ability. The intersectionality of these individual factors, or the ways in which they interact, is also important to consider (Zmud et al., 2017). Nevertheless, certain characteristics of the travel patterns of many seniors are worth illuminating.

Some authors have used life transition theory to explore how the travel patterns of seniors are different than those of other age cohorts (Gustafsson et al., 2012; Pachana, Jetten, Gustafsson & Liddle, 2017; Schafer, 2018). This research points to two major life transitions affecting transportation behaviour: retirement and driving cessation (Pachana et al., 2017). Retirement is an important life transition for at least two reasons. First, fewer trips per day are necessary,

without the requirement to physically travel to work. Second, the type of trips taken throughout the day also change, without a physical destination required every day. However, it should be noted that many other trips, such as medical visits, will increase for seniors, if not on a daily basis (Zmud et al., 2017). Trips which serve other purposes, including to the grocery store, hairdressers, seniors centres, and parks, will only increase in importance to avoid social isolation and keep seniors aging healthy and active (Cvitkovich & Wister, 2001).

Looking at the typical distance traveled for seniors, researchers have found that a senior's travel range typically decreases as they age (Boschmann & Brady, 2013; Wood, 2017; Zmud et al., 2017). In a German study projecting senior travel between 2015 and 2025, Zmud et al. (2017) found that the average distance traveled after retirement was a decrease of 10 km per day from the trip length taken before retirement. In practical terms, the neighbourhood becomes much more important after retirement (Pugh, 2017).

Regardless of the distance, destination and time of day, it is evident that the trip needs of seniors are not being met (Munro, 2016). For instance, Kim (2011) found that 37% of seniors in the U.S. had some level of transportation deficiency, while 8% cited a frequent lack of transportation. A travel survey from Minnesota, designed specifically to measure the transportation needs and barriers of seniors, revealed that an average of 35% of the population had unmet trip needs, which increased to 45% of respondents of the 85-89 year old population

group (Wasfi, Levinson, & El-Geneidy, 2012). A study of seniors in Vancouver found that 85% of seniors living with others were able to secure transportation, while only 58% of those living alone could say the same (Cvitkovich & Wister, 2001). Munro (2016) found that of the travel needs not being met, most of them were not for medical trips, providing implications from a public health standpoint if social trips are not being met. Like many other studies, Turcotte (2012) found that seniors who did not drive as a main form of transportation were less likely to participate in social activities.

### **5.1.2 Driver Cessation**

The Conference Board of Canada released a recent report on the mobility of aging Canadians, finding that for younger seniors between the ages of 65 and 74, 68% reported driving as their main form of transportation (Munro, 2016). This drops to 31% for Canadians 85 years and older. It is understandable then that most research on transportation options for seniors has focused on how seniors are coping with the transition to no longer driving, or the cessation of driving. Most of this research focuses on how the loss of a driver's license reduces an individual's independence and contributes to social isolation, which tends to lead to recommendations of finding ways to keep seniors driving safely as long as possible (Munro, 2016). This perspective ignores the fact that access to services and amenities can be more important than mobility (Vivoda, Heeringa, Schulz, Grengs, & Connell, 2017). Recently, more

balanced perspectives such as the report on transportation and an aging population by the Conference Board of Canada highlights the negative aspects of road safety implications of people driving beyond their ability, and the missed opportunities for increasing physical activity through other modes of transportation (Munro, 2016). Likewise, Ichikawa, Nakahara & Takahashi (2016) found that supporting drivers with alternative modes of transportation may be equally important to helping seniors continue to drive in a safe manner.

Driving is not simply a mode of getting around; driving is ingrained in social consciousness and tied up within issues of gender, socioeconomic and household status, and perceived freedom and independence (Hwang & Hong, 2018; Pachana et al., 2017). The obtaining of a driver's license is often conflated with becoming an adult (Liddle, Turpin, Carlson, & McKenna, 2008). It is not surprising then that giving up a driver's license can result in a range of strong emotions (Liddle et al., 2008). Some seniors have even described being forced to stop driving as a death sentence (Whitehead, Howie, & Lovell, 2006), and that giving up a license can be akin to the death of a close friend (Pachana et al., 2017). Some may see it as yet another loss in the aging process, or even the last thing they have control over (Curro, 2012), while others see it as the symbolic start of getting older and becoming part of an older cohort (Pachana et al., 2017; Whitehead et al., 2006).

Despite research that shows driver cessation is a gendered process, there are few recommendations to taking a gendered approach to addressing the problem of driver cessation (Rosenbloom & Herbel, 2009). Hwang & Hong (2018) found that women were more likely to view their driving abilities as waning, and thus more likely to stop driving. Women may also be more used to being passengers and asking for more rides and are therefore more prepared to stop driving (Schafer, 2018). Likewise, Hawley, Smith & Goodwin (2017) found that men tended to rate their driving skills higher than women. C. M. Morgan, Winter, Classen, & McCarthy (2009) in their literature review found that men were more likely to stop driving due to health reasons, and thus, educational interventions should focus on this risk.

Driver cessation is rarely sudden and could be even more gradual with proper planning and support (Haustein & Siren, 2014). Liddle et al. (2008) found three stages of driver cessation. The first stage is pre-decision. This is when individuals focus on how to keep driving safely by self-regulating but are not yet planning ahead (Liddle et al., 2008). Examples of self-regulation include not driving at night, in inclement weather, or on highways, or making only right-hand turns (Adler & Rottunda, 2006). However, while self-regulation tends to be common with older drivers, there is mixed evidence that such restrictions lead to an increase in road safety (Rudman, Friedland, Chipman, & Sciortino, 2006). Self-regulated driving tends to be the most common in women and drivers over the age 80 (Hawley, Smith, & Goodwin, 2017).

This first stage of driver cessation is also where potential interventions need to occur, but usually do not (Liddle et al., 2008). Planning ahead can help ease the practicalities of finding other suitable modes of transportation, ease the identity crisis many experience (Craik & Frank, 2017), and reduce the chauffeuring burden on family and friends (Litman, 2015; Mezuk & Rebok, 2008). Such interventions should include teaching seniors how to maintain and increase social networks, problem-solving skills, and adaptability, thus countering some of the negative implications of driver cessation (Haltiwanger & Underwood, 2011). Such programs need to be targeted at specific populations, should use multiple methods, such as written and online materials, in-classroom sessions, and be geographically targeted with relevant alternative transportation options (Bryanton & Weeks, 2014). Individualized transportation planning is a promising intervention, one which may be helpful to include families (C. M. Morgan et al., 2009).

The second stage of driver cessation, according to Liddle et al. (2008), is the decision phase, when individuals make the decision to actually stop driving. This decision is often due to a trigger event occurring, such as a minor or near-collision, or from a health factor such as a stroke (Mezuk & Rebok, 2008). Interventions that occur during this stage need to be careful with language, as well as emotional support, ensuring the decision is seen to be in the hands of the driver (Liddle et al., 2008). Mezuk & Rebok (2008) found that those who did not make the

decision themselves had the hardest transition to stopping driving. Those who fared the best were those who planned ahead and drove less during a 1-5 year period beforehand (Mezuk & Rebok, 2008).

Doctors and other healthcare professionals play a role in driver cessation, but this role needs to be clarified and better standardized (Schryer, Boerner, Horowitz, Reinhardt, & Mock, 2017). A doctor's advice to a patient to stop driving has been found to increase the likelihood of the giving up of a license (Levasseur, Coallier, & Gabaude, 2016). A recent Canadian survey conducted by State Farm Insurance found 94% of respondents said advice from a healthcare professional would make them consider giving up driving (Slaughter, 2018b). Currently, however, doctors are reluctant to advise patients to stop driving due to the concern that it will negatively affect their relationship, which is often quite well-developed (Hassan, King, & Watt, 2015). Doctors are also aware of the correlation between driver cessation and a decline in health (Schryer et al., 2017), and there is evidence that doctors may not feel fully equipped to recognize when patients should stop driving, or when to send them for further testing (MacDonald & Hébert, 2010; Tuokko, McGee, Gabriel, & Rhodes, 2007). Research shows that education can increase the confidence of doctors in broaching the subject with their patient, as well as in their decision to report drivers they think may be unsafe (Byszewski et al., 2017).

Another solution to this dilemma for doctors could be having another health professional conduct the initial driver medical exam, such as an occupational therapist who is more versed on the issue and do not have the same established patient relationship to jeopardize (Hassan et al., 2015). They should be familiar with the driving cessation process and should have local transportation resources available (Craik & Frank, 2017). Ultimately, healthcare professionals need to balance the traditional role of individual patient care with the implications of legal and public safety (Byszewski et al., 2017).

While Bryanton & Weeks (2014) found that some older drivers expect family members to provide information related to driver cessation, family members tend to believe that doctors should play a larger role in facilitating this (Perkinson et al., 2005). A lack of public information about driving cessation can make an already difficult conversation even more difficult for family and friends, who may have already noticed a decline in driving ability but are unsure of how to address it (Hassan et al., 2015). Family members should be educated on signs that point to warning signs (Bryanton & Weeks, 2014; Perkinson et al., 2005) and should be educated on other transportation options available (Slaughter, 2018b). A recent Canadian survey showed 27% of respondents said advice from friends and family would make them consider driver cessation (Slaughter, 2018b).

The third stage of driver cessation is life after driving, which will be harder for those who have not used alternative means of transportation prior to driver cessation (Liddle et al., 2014). One way people tend to cope with not driving is simply by going out less (Liddle et al., 2014), which can lead to isolation and a decline in mental and physical well-being (Rudman et al., 2006). These practical and cultural implications of stopping driving (Liddle et al., 2008) lead to the very real fact that many people drive beyond their ability (Adler & Rottunda, 2006). Since 2010, senior drivers in Canada have consistently been the age group which experienced the most fatalities (Slaughter, 2018b). This is alarming for two reasons. First, because this trend of older drivers experiencing the most deaths on the road is a new trend, and second, because it could spike as baby boomers continue to drive into their old age and their abilities wane or cognitive issues increase (Slaughter, 2018a). In Japan, a country which is considered extremely aged, 40% of car crashes in one year were caused by those over 75 (Ariga & Matsubishi, 2016).

An editorial by public health officers argue that ultimately, public safety should come before personal decisions around driver cessation and recommends the interesting step of graduated de-licensing (MacDonald & Hébert, 2010). Restrictions could follow the steps many take to self-regulate, such as not driving at night when older drivers may be less aware of hazards and signage or at rush hour (MacDonald & Hébert, 2010; Nasvadi & Wister, 2009). A study in British Columbia by Nasvadi & Wister (2009) found that restrictions placed on drivers

after the age of 80 helped reduce crashes. They also found that drivers with restrictions were able to keep their licenses longer than those without restrictions. However, Dickerson et al. (2017) argues that further research is needed to establish appropriate interval testing, particularly with finite government resources required for testing.

#### **4.1.3 Walking**

Walkable neighbourhoods offer many benefits for seniors in the realm of health (Hooker, Cirill, & Wicks, 2007). They promote exercise, improve access to other activities, and lower risk of chronic disease, among other benefits (Hooker et al., 2007). Walkable places can also serve to increase social interactions within a community, increasing its social capital and cohesion (Engel et al., 2016; Ottoni, Sims-Gould, Winters, Heijnen, & McKay, 2016; Public Health Agency, 2017). In a study on walking destinations and seniors in Australia, Nathan et al. (2012) argues that more than walking infrastructure needs to be built; social infrastructure needs to be built.

As the radius of seniors' travels diminishes, the immediate neighbourhood becomes much more important for seniors (Pugh, 2017). When the conditions are right, walking offers an accessible, safe, low-cost and convenient mode of transportation (Gauvin et al., 2012; Nathan et al., 2012). A study in the highly walkable West End of Vancouver found that seniors were five times more likely to walk for transportation than the regional average (Winters, Voss, et al., 2015). Unfortunately, many seniors in Metro Vancouver live in suburban environments which do

not tend to be very conducive to walking (Public Health Agency, 2017). Land uses designed for cars create distances too far to walk to destinations, and the built environment usually treats pedestrians as an afterthought (Gauvin et al., 2012). Mixed land uses with many services and amenities are correlated with more walking and longer walking trips, for all ages (Gauvin et al., 2012).

Many factors account for why a senior chooses to walk, including intra-personal and cultural factors, the natural and built environment, and policy (Garrard, 2013). Garrard (2013) argues that too much research has focused on the former, coming from the health disciplines, while less has focused on the role of the built environment. Until recently, research that has focused on the built environment has often failed to look through the specific lens of aging (Michael, Green, & Farquhar, 2006; Cerin, Nathan, van Cauwenberg, Barnett, & Barnett, 2017).

A study by Nathan et al. (2012) found that destinations needed to be within 400 metres for seniors to walk to them. Likewise, Cerin et al. (2017) and Negron-Poblete, Séguin, & Apparicio (2016) found that 500 metres is a better indicator of physical activity in older adults than the often used all ages standard of 1-1.6 km. Street connectivity can be improved through cutting pedestrian paths through longer blocks (Urban Land Institute, 2015). One reason that destinations need to be closer is older adults have a slower average walking speed than other adults (Montufar, Arango, Porter, & Nakagawa, 2007). Attention also needs to be paid to

optimizing crosswalk timer countdowns with seniors in mind (Kerr, Rosenberg, & Frank, 2012), as many seniors simply do not have enough time to cross the street (Lockett, Willis, & Edwards, 2005). A recent study in Quebec found that the standard 1.2 metres per second used is insufficient for safe crossings by seniors (Lachapelle & Cloutier, 2017). Likewise, a study of older adults in Winnipeg recommends using an average of one metre per second when considering pedestrian times (Montufar et al., 2007).

A study by the American Association of Retired Persons (AARP) found that 50% of adults aged 50 and older reported not being able to safely cross the main roads near their homes, and that they would walk and bicycle more if they could (Yen, Fandel Flood, Thompson, Anderson, & Wong, 2014). As pedestrians, seniors are most at risk of being killed or experiencing a serious injury (The Council on Aging of Ottawa; Age Friendly Ottawa; Ecology Ottawa, 2016). Between 2000 and 2010 in Canada, 43% of pedestrian deaths were of those aged 56+, an age group which only makes up 20% of the total population (The Council on Aging of Ottawa; Age Friendly Ottawa; Ecology Ottawa, 2016). Studies show that when pedestrians are hit by vehicles traveling 30 km per hour, they can survive (Kendall, 2016). The same cannot be said of 50 km per hour speeds, the default speed limit of most cities. Reducing speed limits, and designing streets to encourage lower speeds, would be a key step in improving pedestrian safety, particularly for older adults who are even more vulnerable (Kendall, 2016). The City of

Vancouver's Pedestrian Safety Study found that 75% of all collisions involving pedestrians occur at intersections, and that the vast majority of these collisions were when pedestrians had the right of way (Sayed, 2012). Accordingly, the report recommends a variety of intersection improvements including leading pedestrian intervals providing a head start and establishing right of way for those walking at intersections, restricting right turns on red lights, separate signals and bays for left turns, installing corner bulges to slow cars and reduce crossing distance for pedestrians, and improving street lighting to increase visibility of pedestrians (Sayed, 2012). Unsurprisingly then, well-maintained sidewalks, and street lights are positively correlated with walking in seniors (Cerin et al., 2017). Personal safety from crime may also be important to consider when considering walking trips (Lockett et al., 2005), but more from a recreational lens (Gauvin et al., 2012).

Washrooms and benches, often considered amenities for the general population, become imperative for many older adults (City of New York, 2013; Lockett et al., 2005). Ottoni et al. (2016) found that the simple infrastructure of benches can act as mobility aids, improve mental health by increasing access to nature, reduce crime by adding eyes on the street, and increase social interaction among seniors. It is also important to remember that disabilities are more prevalent in seniors than other populations, with 33% of Canadians over 65 reporting a form of disability (The Council on Aging of Ottawa; Age Friendly Ottawa; Ecology Ottawa, 2016).

Facilitating walking for those with disabilities requires additional consideration, such as using tactile surfaces for those with disability impairments (Tactile Walking Surface Indicators (TWSI), n.d.). Raised crosswalks can serve to protect pedestrians by slowing drivers down and were highlighted as a high priority in Vancouver's Pedestrian Safety Study (Sayed, 2012).

One characteristic of a walkable environment is not enough; for a neighbourhood to be truly walkable for seniors, the intersectionality of characteristics such as land-use, street connectivity, maintained sidewalks, and benches is imperative to consider (Yen et al., 2014). These can be supplemented with promotional tactics, such as a comprehensive wayfinding strategy designed with seniors and people with disabilities in mind (National Aging and Disability Transportation Center, 2016c; Transportation for Massachusetts, 2015). For example, a neighbourhood may have great street connectivity and many amenities, but if an older adult cannot safely cross a street to get to them, or does not know how to get there, these benefits are negated (Kerr et al., 2012). Prioritizing improvements with identified popular walking routes and establishing them as safe routes for seniors is a strategy used in New York City (Safe Routes for Seniors, n.d.). Low cost pilot projects utilizing tactical urbanism techniques, or low-cost, temporary interventions to the built environment, may also prove successful (Collaborative, n.d.).

#### 5.1.4 Public Transportation

In urban areas of Canada, 7-16% of seniors use public transit as their main mode, compared to only 4.4% outside of urban centres (Munro, 2016; Turcotte, 2012). While many would surmise that when seniors stop driving they switch to public transit, research shows that this is not the case (Munro, 2016). In fact, public transit trips have been declining for seniors, replaced mostly by driving trips (Munro, 2016). Metro Vancouver is an anomaly, with a 15% transit mode share for seniors, far higher than the national average (TransLink, 2013).

The lack of public transit use by seniors could be because it is currently designed to meet the demands of a population going to work (Rosenbloom, 2009). This focus on commuting has led to minimal research on the perspectives of seniors who are primarily retired (Hess, 2009; Voss et al., 2016). For example, many transit systems reduce service during off-peak hours, which limits the functionality of the system for older users are traveling during these times (TransitCenter, 2016). It also means that there is often a lack of direct service to destinations seniors want to go (Shaheen & Rodier, 2007).

Due to the fact that transit is publicly funded and expensive to build and operate, there can be a tension between the goals of most public transit systems looking to have high, efficient ridership, and serving seniors or expanding coverage areas (Walker, 2008). For example, adding bus stops can slow down the system (Walker, 2018), while increasing access for many seniors

and persons with limited mobility (Broome, Worrall, Fleming, & Boldy, 2012). Thus, focusing more on seniors using transit may require a shift in public transit policy (Walker, 2008). It will also require more funding for the public transit system overall, which can be done by addressing the inequity of the amount of funding that goes to automobile transportation (Hikichi & Beimborn, 2006; Litman & Brenman, 2012).

An equity planning lens might consider transit fares less from a cost-recovery goal to one which removes barriers to its use (Amar & Teelucksingh, 2015). Young (2014) argues that public transit should be free for all seniors, with the goal of driving ridership and reducing the stigma of driver cessation. A study of free public transit for seniors over the age of 60 in England found an increase of transit use at least once a week from 28% prior to implementation to 39% three years after implementation (Webb, Netuveli, & Millett, 2012). The cost of this program was estimated just under £1 billion per year (Webb et al., 2012). Another option would be heavily discounted fares during the day outside of rush hour (Song, Eom, & Kim, 2014), to avoid overburdening an already at-capacity system like Metro Vancouver's (Woodward, 2016). There is also some evidence that many seniors may simply be confused about how much each trip costs (Metaxatos, 2013), which could be solved by having clearer information and simpler payment systems (Metaxatos, 2013; Shrestha, Millonig, Hounsell, & McDonald, 2017).

Many of the suggested improvements to attract more seniors to the system are ones which would benefit all age groups (Burkhardt, 2007). These include an increase in frequency of transit, particularly at busy times when buses get crowded (Hess, 2009). Increasing amenities at bus stops, particularly benches and shelters, may help lower the perceived wait time of all passengers (Fan, Guthrie, & Levinson, 2016). Real time arrival information could also reduce the waiting burden effect and encourage seniors to use transit (Rashidi & Mohammadian, 2009). Distance to bus stops can also be a real barrier to seniors using public transit (Hess, 2012). Due to slower walking speeds, older adults perceive the distance to transit stops as greater than they are (Hess, 2012). Like walking trips, 400m has generally been agreed upon as an average distance seniors will walk to take the bus (Tomšič, Sevšek, & Rugelj, 2017).

Safety, and perception of safety, on public transit can also be a barrier for seniors (Gustafsson et al., 2012). These concerns range from falling when the bus accelerates before getting seated, to perceptions of personal safety related to crime at isolated transit stations, particularly at night (Gustafsson et al., 2012). Reducing fear can be addressed through improving the built environment at transit stops through crime prevention design, such as better lighting at bus stops and adjacent streets or through increased security personnel at night (Loukaitou-Sideris & Fink, 2008; Shaheen & Rodier, 2007). Turning attention to the built environment experienced

walking to and waiting for buses, may actually be more important for dispelling fears (Loukaitou-Sideris & Fink, 2008).

The fear of falling could be at least partially addressed by providing someone to help seniors board, and more seats reserved for seniors (Burkhardt, 2007). Recognizing that seniors may need more time to board transit, Singapore has lengthened the stop time rapid transit train cars during off peak times and created priority queue areas for seniors waiting for the bus, so they board first (Lim, 2015). Other ideas include increasing the number of seats designated for seniors and others with mobility requirements (Burkhardt, 2003), and finding ways to increase the habit of others to offer seats to seniors (Tomšič et al., 2017).

Accessibility needs to be based on principles of universal design which include physical accessibility, as well as sensory and cognitive accessibility (National Aging and Disability Transportation Center, 2013). To achieve true accessibility, local governments can ensure this is integrated into all overarching transportation master plans, transit agencies can integrate goals into all official policies and community groups can advocate from an informed standpoint, as well as document gaps in the system (National Aging and Disability Transportation Center, 2016a). One aspect of accessibility in a transit system that often gets overlooked is that even when stations are fully accessible, the services that make them so may not always be functioning (TransitCenter, 2016). Clear policies need to be established to minimize disruption, notify users

so they can plan ahead, and guarantee alternative access, such as when an elevator is out of commission (TransitCenter, 2016). Cognitive abilities of seniors using the system needs to be considered, including within wayfinding (Kim, 2011). Singapore has modified their rapid transit signage by using sharp colour contrasts and larger font sizes (Senior-friendly enhancements to public transport system in the works, 2015).

Lack of knowledge of how to use public transit is both a real and perceived barrier to more seniors using it (Bryanton, Weeks, & Lees, 2010; McCarthy, Shannon, Lucinda, & Wolf-Branigin, 2010). Many seniors express a willingness to learn if the right supports are in place (Bryanton et al., 2010). One way to capitalize on this opportunity is through teaching seniors how to use the transit system (Shaheen, Allen, & Liu, 2008). An evaluation of a transit training workshop in California which used social learning theory to improve the self-efficacy of participants found increased comfort levels and more trips taken by transit, and fewer by driving, following the training (Shaheen et al., 2008). A study of a transit training program in Victoria, BC found that those who took part in the training were more likely to use public transit than those who did not (Stepaniuk, Tuokko, McGee, Garrett, & Benner, 2008). Interestingly, Babka, Cooper, & Ragland (2009) found that many seniors who enroll in transit training may already be transit users and looking for additional experience. Thus, assessing knowledge and experience before enrolling seniors in order to better segment and tailor programming is important.

Where transit training is taking place, it ranges from one-on-one to group training to train-the-trainer programs to educational seminars to hands-on field trips (McCarthy et al., 2010; National Aging and Disability Transportation Center, 2016d). Successful programs have managed to adapt to local environments, establish strong partnerships within the community for participant recruitment, and find adequate funding sources (National Aging and Disability Transportation Center, 2016d). Programs tend to be either run by transit authorities themselves, or by non-profit organizations and at least partially funded by transit agencies (National Aging and Disability Transportation Center, 2016d). Attention to recruitment is essential to ensuring adequate participation in sessions, and strategies might include going to where seniors are, such as seniors centres and doctor's offices, as well as targeting those currently driving through driver's licensing offices and family members (Babka et al., 2009).

#### **4.1.5 Senior-friendly shuttles**

Shuttles, flexible route transit, demand-responsive transport services, and micro-transit, are services which operate in a space in between paratransit and regular public transit (Ferreira, Charles, & Tether, 2007). Rather than offering door-to-door service like paratransit, shuttles tend to prove popular with seniors due to features of some models which reduce the distance required to walk to the bus, such as allowing for route deviation or bus hailing between stops (Broome et al., 2012). Perhaps more importantly, shuttle routes designed with seniors in mind can connect

them directly to places they want to go (Broome et al., 2012; Bruun & Marx, 2006). Burkhard (2003) found that services that are designed specifically with seniors in mind, with community input and which are marketed appropriately, see an increase in ridership. Some services also feature drivers who can assist with boarding and getting off the bus (Chen, 2010).

A study in a suburban community of Australia found ridership doubled when a regular fixed route service was replaced with a flexible one, and satisfaction with the service increased dramatically, particularly for seniors (Broome et al., 2012). In a study of shuttle services which have been adopted in Finland and Belgium, Nelson et al. (2016) found that they can also ease the demand on paratransit services, which tend to be oversubscribed and extremely costly to operate. Attention, however, needs to be paid that such services do not simply take riders off the conventional system (Y. Z. Wong, Hensher, & Mulley, 2017). Complementing regular bus routes, not replacing them, can help to avoid this (Broome et al., 2012).

Perhaps the best example of shuttles is from Sweden where they have implemented Service Route Traffic buses as part of their public transit system (Wretstrand, Svensson, Fristedt, & Falkmer, 2009). Service Route Traffic features specially trained senior-friendly drivers, smaller, more accessible buses, and shorter distances between bus stops to reduce walking (Wretstrand et al., 2009). In addition, the buses can be hailed anywhere along the route and the schedule is built with lots of time for people to board (Burkhardt, 2007). This was done partly

with the goal of diverting people from the more expensive paratransit system, as an intermediate solution for those who were less mobile and had different needs than the working population (Wretstrand et al., 2009).

Funding for shuttles varies, depending on the service. Locally, the municipality of Delta operates their own shuttle services funded in part by an Age-Friendly Grant, providing free service to seniors in South Delta and North Delta, with routes determined by users on the day (Delta Seniors Bus, n.d.). A great example of a local service made possible through diverse partnerships is the North Shore's Go Bus (Fitzgerald, 2009). The Go Bus is a demand-responsive shuttle with multiple, senior-oriented destinations and is operated by Silver Harbour Seniors Activity Centre, with support from a variety of private, non-profit and public stakeholders (Fitzgerald, 2009). Technology in booking and routing systems are increasingly making these services more feasible (Nelson, Wright, Masson, Ambrosino, & Naniopoulos, 2010).

#### **4.1.6 Paratransit**

The goal of paratransit is to provide vulnerable groups, such as those with a form of disability, with the same access to transportation services as people without disabilities (WenZhao & XiaoKuan, 2016). To do this, paratransit provides door-to-door service to people considered eligible based on ability (HandyDART, n.d.). The 2009 National Household Travel

Survey revealed that less than 0.5% of all trips for those over 70 were done by paratransit (Rosenbloom, 2013). However, while paratransit will never be a significant mode share for seniors, there are many who rely on the service as a fundamental form of transportation. Rosenbloom (2013) argues that the eligibility of riders to use paratransit may be an issue when considering seniors, as most do not have serious disabilities for most of their senior years and thus might not be able to use the service. At the same time, authorities are reluctant to expand eligibility due to the cost of providing the service (Menninger & Werly, 2015). In 2011, the cost of operating paratransit services in the US was estimated to be \$3.5 billion per year (Menninger & Werly, 2015).

Travel training, which offers paratransit users training on how to use the convention system for some of their trips, can increase ridership on conventional transit, decrease demand on oversubscribed paratransit, showcase the transit agency as customer-driven, and increase the self-efficacy, confidence, and social and employment access of participants (National Aging and Disability Transportation Center, 2016b). In California, in conjunction with improvements to bus stops and accessibility, a \$342,000 was realized in savings following the first year of operation a travel training program (Menninger & Werly, 2015).

A focus on how to improve paratransit for riders often looks at better employing technology (TransitCenter, 2016). For example, riders should be able to book reservations online

and through smartphone-based applications, rather than just through phone systems (TransitCenter, 2016). Utilizing GPS can also increase predictability of arrival times and help communicate them, a key concern for riders (Mulley & Nelson, 2016; National Center for Senior Transportation, 2016). However, taking advantage of this technology requires a rider to have access to a cell phone (National Center for Senior Transportation, 2016). Improving algorithm and trip planning tools can provide more flexibility and help accommodate last minute change requests by riders (Menninger & Werly, 2015). Sharing aggregate data between all operators of demand-responsive services including paratransit and senior-friendly shuttles would provide a better analysis of what is working and how improvements to the service can be made (Mulley & Nelson, 2016). Data-sharing and cooperation between paratransit and the healthcare sector also needs to dramatically improve, especially considering many riders use the service to reach medical appointments. In many cities in Europe, healthcare workers directly book the service for their patients (Mulley & Nelson, 2016).

Looking locally, the Seniors Advocate of BC recently conducted a survey of how HandyDART, the paratransit service in BC, was doing in meeting the needs of riders throughout the province. The survey received nearly 7500 respondents, 45% who were from Metro Vancouver, and 70% were female. Overall, satisfaction with the service was relatively high, with 52% always satisfied, and 39% most of the time. Room for improvement mostly centred around

availability, including not being able to get a ride due to high demand, or not enough service on weekends. It also noted that while 91% of users were able to reach call agents in under 5 minutes through BC Transit, only 71% in Metro Vancouver through TransLink were able to do so (Seniors Advocate of BC, 2017).

Perhaps the most interesting finding from the survey is that while 98% would recommend the service to others, 30% say the service only moderately meets their transportation needs or does not meet them well at all. This may be indicative that for some trips it works really well, but for many people, it will not work for all of their trips. For example, 71% of riders use HandyDART to get to medical appointments, but only 6% only use HandyDART for all their trips. Of those aged 75+, 72% found the service met their needs, compared to 63-69% of other age categories.

Like many paratransit systems (Mulley & Nelson, 2016), HandyDART also utilizes a partnership with taxi companies to provide rides for some trips. 79% of Metro Vancouver HandyDART users reported having a taxi ride provided through HandyDART within the last year. Unfortunately, 35% of these respondents said they rarely or never knew when the ride would be in the form of a taxi, making it confusing for seniors waiting for HandyDART shuttles. While taxis were generally rated lower than HandyDART shuttles (Seniors Advocate of BC, 2017), taxis allow paratransit to add flexible capacity (Nelson et al., 2010).

#### 4.1.7 Cycling

There is a lack of research looking at barriers and opportunities for cycling specific to older populations, particularly in North America (Winters, Sims-Gould, Franke, & McKay, 2015). This could be because rates of cycling are so low in these populations (Pucher & Dijkstra, 2003). The City of Vancouver, noted for having a cycling mode-share among the highest in North America, only has a 0.5% cycling mode-share for seniors (Winters, Sims-Gould, et al., 2015). However, it is worth looking at other places with higher cycling rates of older adults. Pucher & Dijkstra (2003) found that cycling makes up 25% of mode share by Dutch seniors. Japan, with a very aged population, has an even higher cycling rate of 29% (Amagasa et al., 2017). Besides the physical benefits (Ryan, Svensson, Rosenkvist, Schmidt, & Wretstrand, 2016), cycling can improve a senior's mobility by extending the distance in which they can travel (Van Cauwenberg et al., 2018). Accordingly, promotional campaigns for older adults should focus on the benefits of exercise, sociability and fun, leading to a sense of empowerment and improved quality of life (Zander, Passmore, Mason, & Rissel, 2013).

Many characteristics of the built environment which will facilitate walking will also serve to make cycling safer, and thus more palatable, for seniors (Cerin et al., 2017). For example, recommended improvements to increase bicycle mode share in North America include reducing default traffic speeds to 30 km per hour through traffic calming design, not allowing right turns

on red lights, and increasing the number of streets where cars must give right of way to cyclists and pedestrians (Pucher & Dijkstra, 2003). Traffic-calmed streets, ubiquitous in much of Europe, have generally been ignored as a solution to promoting walking and cycling in North America due to the lasting impact of the vehicular cycling movement which suggests the best way to increase bicycling is by treating bikes as cars (Pucher & Buehler, 2017). Protected cycling infrastructure has also been found to increase cycling rates of older adults (Aldred, Elliott, Woodcock, & Goodman, 2017). Providing separate infrastructure between cyclists and pedestrians, and not multi-use paths, will also help reduce fear of seniors walking and biking (Winters, Sims-Gould, et al., 2015). Finally, promoting cycling from an early age and encouraging it as a lifelong transportation option will also likely increase the mode share among older adults (Ryan et al., 2016; Winters, Sims-Gould, et al., 2015).

Electric bikes, or e-bikes, which offer electric assist, are extremely popular in advanced cycling nations like China and the Netherlands and are growing in popularity in North America (Dill & Rose, 2012; Pucher & Buehler, 2017). Despite this, policy-makers have paid them little attention (Dill & Rose, 2012), possibly because little research has focused on the topic. E-bikes may overcome barriers such as hilly terrain, prevalent in Metro Vancouver, and help extend trip distance from walking or regular cycling trips (Dill & Rose, 2012; Griffin, 2016). While seniors are regarded as early adopters of e-bikes (Fyhri & Fearnley, 2015), the high cost of electric bikes,

at least compared to regular bikes, will continue to prevent more uptake (Seebauer, 2015). Public policy promoting and providing subsidies can also increase e-bike adoption as it did in Austria (Wolf & Seebauer, 2014). However, such subsidies may be better directed toward the building of safe cycling infrastructure instead (Wolf & Seebauer, 2014).

Recently, bike-share schemes have improved access to biking for many people, growing at rapid rates (Pucher & Buehler, 2017). They have not, however, targeted older people or those with disabilities (National Aging and Disability Transportation Center, 2017). To do so, bike-share fleets need to be more diverse and include options such as e-bikes, handcycles, and trikes (National Aging and Disability Transportation Center, 2017). Many people find cycling easier than walking and can use bicycles as a form of a mobility aid (Andrews, Clement, & Aldred, 2017). Handcycles can be used by those with limited lower body mobility, while tricycles can be used for those with balance issues (Andrews et al., 2017).

#### **4.1.8 Volunteer Ride Programs**

Volunteer ride programs are services generally operated by non-profit senior-serving agencies which use volunteers to drive seniors to destinations (National Volunteer Transportation Center, 2015). The importance of these programs extends beyond their role in the transportation system to social experiences for both the volunteer providing the ride and the senior receiving it (Kerschner & Rousseau, 2008). While only 1% of seniors report using these

programs as their main mode of transportation (Munro, 2016), they often fill the gap between paratransit services designed for those with disabilities and public transit which requires a great deal of mobility (National Volunteer Transportation Center, 2015). Using the Beverly Foundation's 5 A's of senior-friendly transportation, a survey on agencies providing these services in British Columbia found that these services scored high on affordability, a critical measure considering many of them support low-income seniors (Dobbs et al., 2012). One reason they are not used more may be due to a lack of knowledge about the services (Munro, 2016; Rahman, Strawderman, Adams-Price, & Turner, 2016).

The expansion of these services to meet the needs of an ever-growing aging population will require addressing some fundamental issues. First, volunteer driver recruitment and retention are major issues, with a third of agencies in BC reporting shortages (Dobbs et al., 2012). Volunteer drivers tend to be retired, and thus, age out as their own driving abilities wane (National Volunteer Transportation Center, 2015; Saltman, 2018). With younger generations delaying getting their licenses and eschewing car ownership (Bomey, 2016; Quora, 2017), it is likely volunteer driver recruitment will continue to be an issue.

Another issue is the scarcity of operational funding for these services (Dobbs et al., 2012). While volunteer ride programs are more low cost than private one-on-one services due to the utilization of volunteers, they still incur costs to cover volunteer recruitment, training,

coordination and management, vehicle trip costs, insurance, and overall program coordination (Dobbs et al., 2012). In BC, many of these programs are supported by the United Way and Ministry of Health's Better at Home program (Better at Home Program, n.d.). Currently, many of these programs are often oversubscribed and have waiting lists (United Way, 2016). It also means that often only the needs of medical trips are met (Available Ride Programs, n.d.).

Another issue for organizations offering these services is the amount of liability they entail. This is probably why these services are often operated by small organizations, who can take less consideration of risk as they are less likely to be sued by program participants and volunteers and more willing to adapt to the needs of seniors. As organizations grow their programs, they tend to become more risk-averse. While best practices around insurance options can help, liability issues will continue to hamper large-scale efforts of these types of services (Hendricks & Audino, 2011). This may be one of the reasons the BC Cancer Society recently shut down their large-scale volunteer driving program, citing rising operating costs and a lack of volunteers (McPhee, 2016). Several small organizations have emerged to fill some of the need (McPhee, 2016).

Perhaps the biggest opportunity for volunteer ride programs is to increase the coordination and collaboration between agencies (Best Practices in Volunteer Driver Programs, 2017). As a start, sharing of best practices on volunteer recruitment, coordination, training, and

screening would be useful (Best Practices in Volunteer Driver Programs, 2017). Toronto Ride is a partnership of 13 agencies where individual agencies have their own ride programs but utilize the network for rides which they cannot meet, by placing the ride request into a larger pool for other agencies within the network to pick up (Our Services, n.d.). Ride Connection, out of Portland, Oregon, has gone to the next level of integration by working with a variety of partners to feature opportunities for seniors to donate cars and gain travel credits, volunteer travel credits, and a sliding scale based on income and advance notice booking (Burkhardt, 2007).

#### **4.1.9 Taxis and Ride-Sourcing**

The use of taxis by Canadian seniors as a main mode of transportation is very low at 1.2% of those 65-74, but climbs to 2.6% for those 75-84 and 7.4% of those 85 and older (Munro, 2016). 4% of seniors have used ride-sourcing services such as Uber and Lyft (Clewlow & Mishra, 2017). While ride-sourcing services try to distinguish themselves from taxis, they both offer for profit, one-to-one service, and encounter many of the same barriers to serving seniors (Clewlow & Mishra, 2017; Kaminski, 2018). Taxi and ride-sourcing trips may appeal to seniors by providing individualized service but need to be better adapted to the needs and abilities of seniors (National Aging and Disability Transportation Center, 2011). This includes addressing the lack of availability of accessible vehicles and affordability of service, and the inconsistent attitudes and helpfulness of drivers towards seniors (National Aging and Disability

Transportation Center, 2011). Due to the expenses associated with purchasing accessible vehicles and training drivers to be senior-friendly, regulation is needed to ensure these are mandated (Shirgaokar, 2017; Ward, 2017).

While ride-sourcing companies currently offer much more affordable fares than taxis, it is also unclear how large of a price difference there will be between the services when venture capital money runs out and promotional pricing ends (Somerville, 2017). Ride-sourcing companies also have to overcome the technological barriers many seniors face when trying to book rides using a smartphone-based application (Shirgaokar, 2017). Leistner & Steiner (2017) found evidence of training for seniors to be effective in increasing utilization of such services. Meanwhile, partnerships between non-profits and ride-sourcing companies to book rides for seniors could prove effective (Glidden, 2017; Shirgaokar, 2017).

#### **4.1.10 Scooters and Wheeled Mobility Devices**

While seniors on scooters and mobility devices are a familiar sight in urban settings, little research has been conducted on their use as a transportation mode by seniors (May, Garrett, & Ballantyne, 2010). In 2006, there were an estimated 60,000 scooter users in Canada (Mortenson & Kim, 2016). For those who use them, they can represent a source of freedom and independence which allows users to maintain their lifestyle (May et al., 2010). They can also be seen as a replacement to walking, offering the same flexibility, within a limited range (Thoreau,

2015). Other research also shows their use contributes to increased community engagement and independence (Fomiatti, Moir, Richmond, & Millsted, 2014; Thoreau, 2015).

While currently scooters offer low-barrier transportation by not requiring a driver's license or registration, having low maintenance and operating costs, and less stigma and cost than other mobility devices such as wheelchairs (Mortenson & Kim, 2016; Su, Schmöcker, & Bell, 2010), barriers to their use remain (May et al., 2010). To reduce these barriers and improve uptake from more seniors, attention should be paid to matching the right device to the individual, and offering usage training (Fomiatti et al., 2014; May et al., 2010). Further, better integration with other modes of transportation, such as public transit, should be considered (Su et al., 2010).

Typically, users of mobility devices are classified as pedestrians in terms of rules of the road, due to their low speed capabilities (Blais et al., 2012). Regulation will likely become increasingly important as the use of such devices rises with an aging population, which will potentially lead to more space conflicts on sidewalks between scooter users and pedestrians (Blais et al., 2012). The prevalence of scooters in the extremely aged community of Qualicum Beach led to an article in Maclean's magazine highlighting these conflicts (McKinnell, 2009). However, while the perception of conflicts may be high, empirical evidence shows they are actually quite rare (Gitelman, Pesahov, Carmel, & Chen, 2017). Mortensen & Kim (2016) point

to the negative portrayal mobility scooters often get in the media. Nevertheless, there is a lack of research on safety rates of scooters in general (Jancey et al., 2013).

Improvements to the pedestrian infrastructure, such as widening sidewalks and creating room for covered scooter parking (Saanich, 2008), will also be necessary to increasing the use of mobility scooters, and can help reduce conflicts (Gitelman et al., 2017; Korotchenko & Hurd Clarke, 2014). The benefits of increasing social connectedness and independent mobility from the use of scooters is dependent on a built environment that encourages their use and safety of individuals using them (Korotchenko & Hurd Clarke, 2014). This includes consideration of affordability (Mortenson & Kim, 2016). While scooters are generally more affordable than electric wheelchairs (Mortenson & Kim, 2016), and their purchase price seems to be declining, Ontario is one of the only provinces in Canada to provide funding to individuals to purchase them (Smith, Giesbrecht, Mortenson, & Miller, 2016).

#### **4.1.11 Ride-sharing**

Ride-sharing, or carpooling, for seniors is prevalent, with rides from others being the primary way seniors cope after giving up their own driver's license (Hess, 2009; Munro, 2016). Most ride-sharing for seniors tends to be informal, based on current networks of family and friends (Leistner & Steiner, 2017). Perhaps this is why there is a research gap on this topic. Innovations in ride-sharing tend to rely on a high degree of technology use by those using the

system, such as increasing safety by tracking rides (Mulley & Nelson, 2016). However, other ideas include branded destination signs, identification of safe pick up locations and identification badges for drivers and riders (Mulley & Nelson, 2016). Finding ways to promote more ride-sharing could help keep seniors mobile (Heinz & Kelly, 2015).

This concludes the literature review, which has highlighted the main ways seniors can get around, current barriers to these modes of transportation, and how they might be overcome.

## **5.0 Seniors Advisory Committee Focus Groups**

### **5.1 Introduction**

As part of the Seniors on the Move project, a Seniors Advisory Committee was established, in order to hear from seniors themselves about their experiences with the transportation system. Invited to participate by the project partners of Burnaby Community Services, Collingwood Neighbourhood House, Share Family and Community Services, and Silver Harbour Seniors Activity Centre, the Committee is comprised of seniors 75+ who meet one of the Allies in Aging target populations of low-income, English as a second language, or having a disability. The Committee meets quarterly at locations throughout Metro Vancouver, to make it more accessible for members. Transportation to meetings is provided through the project partners.

The inaugural meeting was held in Burnaby on October 26, 2016. Seniors on the Move partnered with a Simon Fraser University Masters of Health Promotion class to conduct focus groups on the barriers seniors currently face in Metro Vancouver when trying to use various modes of transportation. The student groups then employed human-centred design to come up with possible solutions to these barriers.

## **5.2 Methodology of Focus Groups**

In the initial Seniors Advisory Committee meeting, 17 seniors participated and 18 students, breaking into groups of two to four seniors and two to four students to discuss two main topics: the transportation needs and barriers of seniors in Metro Vancouver. 12 seniors were females and five were males. Most participants were aged 75 or older, many had mobility restrictions, many spoke English as a second language, and many were considered low-income. The students took notes on each topic and then provided a copy to the Seniors on the Move team through the professor. These notes were then compiled by the author into one document and analyzed for common comments and themes.

## **5.3 Themes**

The first theme revolved around walking and resulted in the following points being raised: the need for better maintained sidewalks, more benches, washrooms, and streetlights,

hilly terrain providing particular challenges, made harder by inclement weather such as rain or snow. Many seniors reported being very resourceful and looking for ways in which they can increase their comfort and safety on their own, but also that they needed a bit of help to do so. Many participants expressed that as long as they could walk they could get around, but also acknowledged that this limited the range on how far they could go. Some participants mentioned they had chosen to move to a more walkable community. However, walking to a bus stop was challenging for others.

Many participants were still driving, whereas others had given their licenses or had never driven. A few participants reported self-regulating their driving by not driving at night, in the rain or only in their municipality. One participant mentioned practicing driving to a new destination the day before she had to be there, in order to increase familiarity with the route. Another participant described stopping driving due to medical reasons as another chapter in her life, one which she found challenging. Others were concerned they might drive beyond their ability and hurt someone but were unsure how to tell when that might be, and how to balance this with the need to get around. Some participants spoke of how others relied upon them for rides through informal ridesharing/carpooling networks, increasing the importance of their ability to drive.

Of all of the modes of transportation explored, public transit was the most popular topic to discuss, with most participants using it to some degree. It is important to note that despite the questions centring around needs and barriers, many who used public transit regularly praised the system, particularly its affordability. Most of the negativity centred around bus drivers, whose behaviour and perceived attitude were found to be inconsistent. Reported concerns included drivers who needed to be on schedule and were thus often frustrated with seniors who moved slowly or needed the ramp lowered. Others noted this time pressure resulted in the drivers accelerating before they were seated. However, others thought drivers were very respectful and considerate, although they reported visual cues such as using a walker helping. The other main concern was inadequate space on the bus for seniors, who compete for priority with people using strollers and wheelchairs. This tended to be exasperated when the bus was full, which was reported fairly frequently. Better markings of reserved seats were thought to be helpful, as was a public education campaign. Even for those who regularly used the bus, the issue of carrying loads, such as groceries, was reported difficult on the bus. However, one participant reported using a taxi for this purpose, illustrating that one mode does not need to meet all trip needs. Finally, a lack of bus shelters to protect from the cold and rain, was noted by several participants.

In terms of accessibility, a temporary lack of access such as when the elevators were down, was viewed as not acceptable and had participants wondering if temporary elevators such

as used on construction sites could be utilized. Those who used community shuttles, such as the North Shore's Go Bus, wanted to see them in other communities, but also thought the payment system should be integrated with the public transit system provided by TransLink. Others who did not have access to a shuttle noted that there needed to be a service in between the conventional bus and HandyDART.

Volunteer ride programs generally received high praise, particularly when it came to the friendliness of the driver and reliability. Concerns existed around liability and some vehicles being hard to get in and out of, and a lack of volunteers and availability. Participants tended to not mind asking for rides through these programs, however some participants only used these volunteer ride programs for trips they deemed essential, such as medical ones, due to the cost per trip or not wanting to "take advantage". Some participants reported the services providing them a sense of independence.

Like volunteer ride programs, HandyDART was perceived by some to be only for medical appointments, which could be because some participants were under the impression trips had to be booked a week in advance, or because it was considered only for people with severe disabilities. There was also a lack of understanding about the taxi saver program and the eligibility requirements to enroll. For those using it, the door-to-door service of HandyDART was greatly appreciated, although it was noted that it is more expensive than regular transit and is

not integrated with the Compass Card system used on the rest of the public transit system. Concerns centred around inefficiencies of the system that resulted in two separate shuttles collecting two people from the same place at the same time, to not knowing when a taxi would show up in the place of a HandyDART shuttle. Others noted that the service did not guarantee one will get somewhere on time, which seemed especially problematic for medical appointments. Some participants reported using HandyDART at night to increase safety, while others reported a stigma around riding it. Perhaps the most common theme that emerged was a lack of what type of vehicle to expect when.

Throughout the transportation modes, there was a lot of concern around safety. This ranged from keeping oneself and others physically safe while driving and feeling safe getting on and off buses, to a fear of personal safety of being alone at night waiting for transit. Suggestions to overcome this ranged from taking more personal responsibility such as knowing where the safety features were located on transit, to needing improvements to the built environment such as better lighting.

## **5.4 Suggested Solutions**

Through a process of human-centred design, the Masters of Health Promotion student groups came up with a number of potential solutions, prototyped them, and presented their final conclusions to Seniors on the Move. The first group focused on the high ratings volunteer driver

programs received, but also the challenges associated with operating them, leading to the suggestion to make an app that would connect younger drivers with seniors needing rides directly, utilizing Facebook networks. This was a forward-thinking idea to a more technology-embracing baby boomer generation, one which would both help expand seniors networks and fill the gap between the conventional bus service and HandyDART through carpooling (Unknown, 2016a).

The second group looked at two frequently cited needs of seniors when walking or taking transit: more benches and washrooms. Recognizing that infrastructure can be expensive, especially given the scale of the problem, the group focused on utilizing existing infrastructures by proposing to partner with existing businesses to become certified as senior-friendly by opening up their bathrooms beyond customers, and to source an add-on to street poles to make them into seating. The third idea was a seniors-only car that could operate for certain hours on the SkyTrain system, a response to a lack of seating on transit for seniors (B. Wong, Milley, & Zhuang, 2016).

The third group came up with a series of ideas that together would be a seniors-linking network comprised of a scooter sharing scheme, seniors-friendly buses, a hub for seniors transportation information, ride-sourcing service designed for seniors, and a car-sharing model pairing seniors who own cars but no longer drive with younger people who drive but do not own

cars (Unknown, 2016b). The final group's idea centred around bridging the gap in transportation knowledge cited by the seniors, through setting up a dedicated transit information hub which would provide multilingual information by phone or in person on all seniors transportation services in the region (N. Morgan, Ranjan, Singh, Uy, & Yogaratnam, 2016). The centre would be operated by volunteers (N. Morgan et al., 2016). All of these ideas have potential, as well as challenges that present themselves. They also illustrate the fact that not all solutions need to be expensive, and that a wide variety of ideas need to at least be tried.

These ideas, along with the direct focus group results, were presented to both the Seniors Advisory Committee and the Steering Committee for discussion and feedback. Within the capacity of Seniors on the Move, the idea of the seniors transportation hotline and resource hub was decided upon as the most salient. Partnering with bc211 to host the hotline, and BEST to develop the resource hub, Seniors on the Move has received additional funding from ICBC, Vancouver Coastal Health, and TransLink to pilot this in Metro Vancouver, with an anticipated launch date of June 2018. The hotline and hub will be marketed through driver cessation brochures created by Seniors on the Move, with the intention to distribute them through ICBC's notice to renew auto insurance, among other promotions.

The Steering Committee of Seniors on the Move has tested many solutions to improve transportation options, beyond the transportation hotline and hub project. These include

implementing transit training for seniors as a partnership between TransLink and the project partners. Through a partnership with Modo, the project partners have recruited more volunteer drivers by both recruiting through Modo's membership base and by removing a barrier to potential volunteers by providing access to a fleet of vehicles. An insurance working group has formed to create a policy toolkit advising organizations running volunteer driver programs of insurance options. The project partners have also begun offering one-on-one and shuttle rides for social trips for seniors, and have begun sharing shuttle buses and drivers through the Bus Co-op. Finally, the Steering Committee is looking at hosting drivers cessation workshops which will feed into the transit training, and potentially, mobility workshops.

## **6.0 Exploring Seniors Transportation Solutions through Digital Stories by Seniors**

An additional data source used for this paper was the digital storytelling of seniors in Vancouver. Filmed in 2013 as a project of South Vancouver Neighbourhood House Seniors Hub, these fifteen short videos highlight the impact different modes of transportation have on the lives of seniors in the area. The first video highlights how difficult it can be navigating a scooter onto a crowded SkyTrain car or elevator, and how the range of a scooter limits destinations. In another, a public transit user talks about how the introduction of rapid transit can mean a removal

of some bus stops, placing them out of walking distance. Another transit user describes how hard it can be standing while waiting for the bus, while another how difficult it can be to balance with the sudden acceleration and braking of the bus. One senior highlights the need for shelters and benches and friendlier bus drivers. Others reflect on how the weather and topography can affect their use of walking to get around, while another worries about the presence of crime after being mugged. All public transit users talk about how the difficulties they face are compounded by the crowded conditions (Exploring Seniors Transportation Solutions Through Digital Stories, 2013).

In one video, a HandyDART user talks about the language barriers that can be experienced for those who do not speak English, and about the need for a warning call right before pick up so she can avoid waiting in the rain outside for too long. On the other hand, she cites how helpful the drivers can be, and how grateful she is for the service to get her around. Others talk about how the scheduling and routing of HandyDART can be frustrating and require a lot of wait time. A former cyclist talks about how being hit by a car put her out of commission for three to four months and how she had to adjust to the long-term planning and booking required by HandyDART. Another HandyDART user highlights the friendliness of some drivers, but how complaints about negative experiences are not handled anonymously (Exploring Seniors Transportation Solutions Through Digital Stories, 2013). It is worth noting that in order to reduce

the trepidation of some users about lodging complaints, TransLink has recently moved the customer service department of HandyDART in house, separate from the service provider (HandyDART Frequently Asked Questions, n.d.).

Another senior talks about how a collision while driving forced her to reconsider her abilities and how the decision to give up her license has made her plan her trips out more and rely on others, giving up her independence and control. A few talk about how they rely on rides from others, and one talks about how taxis, while expensive, are reliable. A final inspiring story by a 101 year old still who uses the bus and as long as they come frequently and people keep offering him a seat, he intends to keep doing so (Exploring Seniors Transportation Solutions Through Digital Stories, 2013).

## **7.0 Discussion**

This section will examine the themes present throughout the literature review, the focus groups of the Seniors Advisory Committee and the digital stories from the South Vancouver Neighbourhood House.

## 7.1 Themes

The 5 A's of senior-friendly transportation, availability, acceptability, accessibility, adaptability, and affordability, were developed by the Beverly Foundation and are often used a standard to meet the needs of seniors (Dobbs et al., 2012). While the 5 A's tend to be used to evaluate one-on-one ride services (Dobbs et al., 2012), many of the needs which arose from the focus groups, the digital videos and the literature review can be viewed through the lens of the 5 A's. Availability is the first standard, and was reflected with concerns from focus group members around the lack of HandyDART service on evenings and weekends, the limited availability of volunteer ride programs, and the need for more frequent bus service on some routes. For example, some focus group participants reported self-limiting their trips on volunteer ride programs by only using them for medical purposes. This was not a theme illustrated in the literature. However, a lack of availability of rides due to programs being unable to meet the demand of requests was a common problem cited in the literature (Dobbs et al., 2012; United Way, 2016). Likewise, the desire from seniors for an increase in frequency of bus service was reflected in the literature (Hess, 2009). The lack of availability of HandyDART during periods of high demand was captured in the Provincial HandyDART survey (Seniors Advocate of BC, 2017).

The second standard of senior-friendly transportation is acceptability (Dobbs et al., 2012). Comments around HandyDART included a wait time window which could be too long and the need to schedule far in advance to guarantee a ride. Public transit and taxi concerns centred around the senior-friendliness of drivers, with both themes being well documented in the literature (Wrestrand et al., 2009; National Aging and Disability Transportation Center, 2011). Concerns around personal safety on public transit was a common theme in the literature (Gustafsson et al., 2012). Other themes, such as a lack of bus shelters and the need for services between paratransit and regular buses were also well documented in the literature (Fan, Guthrie, & Levinson, 2016; Wretstrand et al., 2009). Not knowing whether a HandyDART shuttle or a designated taxi would be coming was a finding in the HandyDART survey report (Seniors Advocate of BC, 2017). Compared to the commonly cited feeling of being for a burden when asking others for rides on a more informal basis, focus group participants tended to not minding asking for rides through volunteer ride programs, which was not found in the literature review.

The third standard of senior-friendly transportation is accessibility. Concerns around the built environment included the physical safety for those walking and cycling, a common theme in the literature (Yen et al., 2014). The walking distance to bus stops was also reported to limit the accessibility of the public transit system for some seniors, a finding also found frequently in the literature (Tomšič et al., 2017). Likewise, the complaints from seniors about not being able to

find a seat before the bus departs and elevators being temporarily out of service illustrates a lack of accessibility for seniors on public transit, also supported by the literature (Gustafsson et al., 2012; TransitCenter, 2016). One finding that was not found in the literature was when seniors move to a more walkable place that is easier to get around. Another new finding was that many seniors reported not driving downtown due to the complexities of driving there and the cost and difficulty of finding parking, but utilizing transit for these trips. In other words, downtown may be considered accessible by transit, but not by car. It would be interesting to see if this finding is present in other cities.

A lack of knowledge about transportation options, or as one student wrote, a lack of transportation literacy, emerged from the focus groups. Examples of this included participants not knowing how to use the bus, not knowing about volunteer ride programs or that they could be utilized for more than just medical trips, and the fact that bus drivers must lower the ramp to help people get on the bus if requested. Some of the comments heard were actually incorrect perceptions. For example, one participant mentioned having to book HandyDART trips a week in advance, when in reality, trips can be booked until 4pm the day before, with a previous deadline of noon (Bernardo, 2017; HandyDART, n.d.). These findings about a lack of knowledge of transportation options and how to access them are consistent with the literature around seniors transportation (Bryanton, et al., 2010; McCarthy et al., 2010).

Affordability, the fourth standard, did not seem to be a common barrier for seniors in using walking, cycling, and public transit. The main concern around the cost of paratransit was its lack of payment integration with the conventional transit system. This specific issue was not found in the literature, but a lack of cooperation between service operators was noted by Mulley & Nelson (2016). Private transportation, including car ownership, taxis, scooters and mobility devices, were cited as costly expenses by participants. Interestingly, the cost of car ownership as a reason for driver cessation was not well reflected in the literature, while the cost of scooters was discussed as a barrier to greater uptake by seniors (Mortenson & Kim, 2016). The high cost of taxi trips was well documented in the literature and one reason for the appeal of ride-hailing (Somerville, 2017). Volunteer ride programs were seen as affordable for some trips, such as medical ones, but less appealing for other, more optional trips. The literature on the affordability of volunteer ride programs from a user perspective is lacking, perhaps because trips tend to be subsidized (Dobbs et al., 2012).

The final standard of senior-friendly transportation is adaptability, which was reflected with concerns about the lack of appropriate vehicles within taxis, ride-sourcing and volunteer ride program fleets. Reports of some volunteer ride vehicles being hard to get into was a finding present in the literature (Hendricks & Audino, 2011). The limitations of HandyDART for those trying to combine multiple destinations within one outing was a common theme, and was

reflected in the Provincial HandyDART report (Seniors Advocate of BC, 2017). The discussions around driver cessation can be grouped within the theme of adaptability, as seniors often reported being afraid of not being able to adapt to a life without driving. Self-regulation is a tool that may prolong driver cessation and was reported by many seniors in the focus groups and digital stories. This included not driving at night or the rain, or only in their municipality.

Self-regulation techniques were common in the literature (Adler & Rottunda, 2006; Liddle et al., 2008). However, one comment not found in the literature was the technique of practicing a new route beforehand in order to be comfortable driving to a new destination. Finally, some participants reported volunteer ride services provided them with a sense of independence, consistent with literature highlighting the personalized nature of these services (National Aging and Disability Transportation Center, 2011).

## **8.0 Strategic Analysis**

Systems thinking offers a way to examine the components of a system and focus on how they interact to make up the larger, complex system (P. Morgan, 2005). This is important because if one aspect of a transportation system does not work, the whole system will not work for the user. For example, if a senior can comfortably ride the bus, but cannot safely walk there, this no longer a viable mode of transportation. Because all parts of the system are connected, yet rarely

in a linear fashion, changes made will only increase the likelihood of something happening, rather than assuring it will. However, systems thinking offers an opportunity to try and capitalize on these likelihoods through the identification of common leverage points within a system (P. Morgan, 2005).

To improve transportation options for seniors in Metro Vancouver, one needs to look at the transportation system as a whole, with all of its related parts, services and stakeholders through a range of transportation modes. These include any entity with authority for decisions within the system, such as municipalities, TransLink, ICBC, and the Ministries of Transportation and Health. The transportation system can then be analyzed to see what measures might be taken that will increase the probability of seniors being able to easily get around, with appropriate decision-makers identified (P. Morgan, 2005). Meadows (1999), in her seminal paper on where to intervene in a system in order to have the greatest chance of creating real change, identified twelve leverage points, which she ranked by effectiveness and also analyzed by difficulty in implementing. These leverage points were used to evaluate which of the potential solutions for Metro Vancouver's transportation system will have the biggest impact on improving options for an aging population, as well as how feasible each will be. Feasibility is based on the number of implementation stakeholders, the time process likely involved, the resources likely required, and

the potential for political/public backlash, and is ranked as one of the following: very feasible, feasible and not very feasible.

According to Meadows (1999) the least effective leverage point in a system is a change to parameters, constants and numbers, such as taxes and subsidies. While people tend to think these are quite important, these changes tend to rarely be substantial enough to impact behaviour on a large scale. Effort should be placed on more effective leverage points to make a bigger impact (Meadows, 1999). With this in mind then, making public transit free for seniors is unlikely to dramatically increase seniors' use of the system, and the high cost of doing so (Webb et al., 2012) would be better spent on other initiatives (Meadows, 1999), such as senior-friendly shuttles. In addition, the BC Bus Pass Program already offers \$45 a year unlimited transit for low income individuals receiving the General Income Supplement (BC Bus Pass for Seniors and Others, n.d.). Likewise, eliminating fees from volunteer ride programs is unlikely to make much difference, as the affordability of these are not usually a barrier to seniors due to the sliding scales of most programs (Frequently Asked Questions (FAQ), n.d.). While reducing or eliminating transportation fees would reduce barriers for some individuals, there are other leverage points that could be used to create a much larger impact (Meadows, 1999). Eliminating transportation fees for some senior-friendly transportation services would require implementation from service providers, and significant funding from provincial-level authorities. This could be

done fairly quickly assuming political will, and would be unlikely to run into considerable public backlash, although a perception of special treatment for one age group may arise. This leverage point is feasible, but would also not be that effective, according to Meadows (1999).

Leverage point eleven, as the second least effective according to Meadows (1999), is changing the sizes of buffers and other stabilizing stocks within the system. In terms of senior-friendly transportation terms, this would be increasing the availability of back-up options, to ensure transportation needs are still met when something went wrong (The Beverly Foundation Legacy, n.d.). For example, if multiple buses break down while in service, having a larger reserve stock will help minimize service disruptions and thus serve customers better. However, it is unlikely TransLink would want to spend resources on more vehicles to be idle much of the time, and would likely require funding from the Province. Thus, this is not very feasible. Adding more senior-friendly and accessible vehicles within taxi, ride-hailing, and volunteer ride service fleets would also increase the availability of these vehicles at any one time (Ward, 2017). While increasing the buffer size of accessible vehicles will not prove to have a large systems effect, it would make a large difference for some individuals (Ward, 2017). Doing so would modify the regulation on taxis and ride-hailing (when approved) by the Passenger Transportation Board, likely directed from the Province. While this would increase the costs for operators, the Passenger Transportation Board, responsible for decisions on applications

relating to the licensing of passenger directed vehicles, including taxis, limousines and shuttle vans (Index, n.d.), has the authority to ensure this happens. This would not take too long to enforce, and would likely not encounter much political backlash, and thus is feasible overall.

Increasing a range of accessible vehicles within volunteer ride programs would likely require a coordinated approach to create a regional network, requiring the cooperation of a multitude of volunteer ride providers, some external funding, and a considerable amount of time. This would likely not run up against much public outcry. Overall, this is feasible. Likewise, increasing the number of rides on offer from volunteer ride programs would vastly improve the service for seniors, but would require finding more volunteers to drive seniors around, which is perhaps the biggest challenge these programs face (Dobbs et al., 2012). However, with sufficient funding and time, finding more volunteers to increase ride availability could be feasible.

The tenth leverage point looks at the structure of material stocks and flows and how they intersect and interact, or the physical design of the system itself (Meadows, 1999). In terms of Metro Vancouver's transportation system, this requires looking at how we have built our cities and how this influences how seniors can get around, and what we can do to change this (Meadows, 1999). This concerns both land use and the built environment. For example, inclusionary zoning policies and Transit Oriented Development can increase access to services (Upstream Public Health, 2015). The implementation and acceleration of these policies would

require the cooperation of municipalities, TransLink, and developers, could be done relatively quickly, would require few resources, and would likely encounter a moderate amount of public outcry, particularly with more inclusive zoning. Thus, this would be feasible, and somewhat effective.

Increasing the senior-friendliness of the built environment will need to include accessible, well-maintained, wide sidewalks, protected bicycle lanes for all ages and abilities, adjusting the crosswalk timers to accommodate slower speeds of seniors, leading pedestrian intervals, and raised crosswalks (Montufar et al., 2007; Pucher & Dijkstra, 2003; Sayed, 2012). It also means not building any more capacity for cars within the system, such as adding more car lanes and parking (Boarnet, Joh, Siembab, Fulton, & Nguyen, 2011). With most seniors living in auto-oriented, low-density suburbs (Turcotte, 2012), retrofitting these places to be senior-friendly will be difficult, if crucial (Boarnet et al., 2011). Retrofitting and not adding additional capacity for cars will need the co-operation of municipalities, TransLink, ICBC and the Province, will be resource and time-intensive, and will likely encounter considerable public opposition. Therefore, this is not very feasible overall but will be necessary, and relatively effective in the long-term (Meadows, 1999).

The ninth leverage point is decreasing the length of delays within feedback loops, or finding a way to respond quickly to changes in demand occurring within the system (Meadows,

1999). It is common in transportation to discuss the concept of latent demand, or demand that exists but is not noticed because appropriate infrastructure is not in place (Litman & Colman, 2001). For example, it is very likely that increasing walking, cycling, and public transit options for an aging population which will be driving less by improving and building new infrastructure will reveal a latent demand for their use (Kemperman & Timmerman, 2009). Recognizing this latent demand, and designing to accommodate it, could be very effective (Meadows, 1999). However, doing so would not be very feasible, because many delays, such as the construction time of a new rapid transit line, cannot be sped up (Meadows, 1999). It would require all Metro Vancouver stakeholders, including municipalities, TransLink, health authorities, the Province, ICBC, and the Federal Government (for capital projects) to work together to share relevant data in a timely manner, and would take a considerable amount of time to implement. Despite this being unlikely to encounter significant public outcry, reducing feedback delays is not very feasible.

The eight leverage point looks at using negative feedback loops to try and correct demand for something that is oversubscribed (Meadows, 1999). For example, raising the price of parking can moderate the demand for those spaces and increase availability of some spaces at any given time. This is important because, like many economic markets, the price of transportation to consumers does not reflect its true costs (McLaren, Havlak, & Stewart-Wilson, 2015). This is

particularly true with driving, which is vastly subsidized through general operating funds of all levels of government (Su & DeSalvo, 2008). To correct this, some cities have implemented road pricing, a comprehensive system of charging for driving (Chang, Tseng, Hsieh, Hsu, & Lu, 2018). Therefore, the artificially low cost of driving might encourage many seniors to keep driving longer than they might otherwise, and often beyond their ability (Vivoda et al., 2017). It also means that the money that could be spent on improving other transportation options, is instead spent on encouraging driving (Su & DeSalvo, 2008). However, introducing road pricing would require the cooperation of multiple stakeholders, including municipalities, TransLink, the Province and ICBC, would take a long time to implement, the technology needed would require considerable resources, and perhaps the biggest barrier would be public outcry, which would have to be overcome by strong political will. Thus, implementing road pricing is not very feasible, but would be quite effective, according to Meadows (1999).

Besides increasing the cost of driving to moderate demand, reducing space dedicated to cars would also produce a negative feedback loop and encourage seniors and others to become comfortable with other options (Meadows, 1999). The freed up space from excessive parking and car lanes could be well utilized for other modes of transportation, creating positive feedback loops, leverage point seven (Meadows, 1999). This would be mostly the purview of municipalities, although TransLink and the Province could reduce capacity on the roads under

their authority. While it would likely meet with public opposition, this is already happening in some municipalities, such as the City of Vancouver (City of Vancouver, 2017). For the whole region, this would take some time to achieve, would require a fairly significant amount of resources, and is thus not very feasible overall to help seniors get around.

In a transportation system, positive feedback loops can be seen when infrastructure reinforces behaviour, or induces demand, providing impetus to build yet more infrastructure (Litman & Colman, 2001). To improve and increase transportation options for seniors then, positive feedback loops can be created, leverage point seven, by increasing the accessibility, availability, adaptability, acceptability and affordability of these options (Meadows, 1999; The Beverly Foundation Legacy, n.d.). For example, providing more frequent public transit service will encourage an increase in ridership, wider sidewalks with curb cuts will see more foot traffic, and more protected bike lanes built for all ages and abilities will see more people riding bikes (Kemperman & Timmerman, 2009). A common saying in transportation is “if you build it, they will come” (Scribner, 2016). Extending this, once more senior-friendly transportation infrastructure is built, more seniors will use it, and then even more can be built (Meadows, 1999). Better pedestrian and cycling infrastructure will be mostly the responsibility of municipalities, although cost-sharing can occur with TransLink, ICBC, the Province and health authorities, will be of moderate expense, can be at least started quickly, and will likely meet

moderate outcry from the public. Overall, it is feasible. More frequent public transit will mostly be the responsibility of TransLink, with funding from the Province, can be done fairly quickly, will likely not meet much opposition, and will require moderate resources. This too, is feasible.

A point of caution needs to be made with creating positive feedback loops within volunteer ride programs and the HandyDART systems. Both will see an increase in demand due to an aging population, without the introduction of positive feedback loops (Dobbs et al., 2012; Doherty, 2013). Because of the resource intensiveness and limited capacity of these door-to-door services, negative feedback loops may need to be introduced (Meadows, 1999). For example, volunteer ride programs may need to increase the prices for some rides, while ensuring they are still affordable for low-income populations. This would require legislative changes, as currently volunteer ride programs are only allowed to charge to cover the cost of fuel and vehicle maintenance (Fitzgerald, 2009). Moderating demand for HandyDART is also why TransLink is beginning to offer travel training to help riders use conventional transit for some trips, where appropriate (Saltman, 2017a). Introducing senior-friendly shuttles to the system would also serve to moderate demand on volunteer ride programs and HandyDART (Mulley & Nelson, 2009). For best results, senior-friendly shuttles would require collaboration from TransLink, municipalities, health authorities and senior-serving agencies, with Provincial funding, could be done in a

relatively short amount of time, would be of moderate expense, and would be unlikely to meet much public resistance. This then is very feasible.

Leverage point six is providing new access to information and existing services in order to change people's behaviour within the system, which can be a much cheaper intervention than building new infrastructure (Meadows, 1999). This is the reason transit and travel training have considerable potential to increasing transportation options for seniors (Menninger & Werly, 2015; Shaheen et al., 2008). It is also the theory behind the Seniors Transportation Hotline and Hub project created by Seniors on the Move (Williams, 2018). Increasing information flows will also be extremely important in addressing the negative impacts of driver cessation (Windsor & Anstey, 2006). More resources need to be provided to those no longer driving, as well as to those still driving, so they can plan how to get around after giving up their license (Byszewski et al., 2017). Likewise, resources targeting families and caregivers can help seniors find other ways to get around and signs that someone should no longer be driving (Perkinson et al., 2005). Finally, increasing information flows between all stakeholders including policymakers, medical professionals responsible for giving medical examinations for drivers, senior-serving non-profit organizations, TransLink, ICBC, the Province, and health authorities could reduce feedback delay (Meadows, 1999; Mulley & Nelson, 2016).

Travel and transit training is very feasible, requiring cooperation between TransLink, senior-serving agencies and perhaps BEST, would require minimal resources, could be implemented quickly, and would be unlikely to meet any public resistance. Increasing information access to seniors through a hotline will require cooperation between TransLink, health authorities, ICBC, and Seniors on the Move partners (including BEST and bc211), will require minimal resources from a systems perspective, can be done fairly quickly, and will be unlikely to meet political outcry. Thus, it is very feasible. Likewise, increasing information flows between transportation stakeholders including TransLink, ICBC, health authorities, the Province, municipalities and senior-serving nonprofits will require respective cooperation, minimal resources, can be done relatively quickly, and will not likely meet opposition from the public. However, large amounts of bureaucracy within each authority reduces this leverage point to feasible from very feasible.

Moving up the list in terms of effectiveness, leverage point five is changing the rules of the system, which can include social norms, laws, and contracts, depending on the system (Meadows, 1999). Within Metro Vancouver's transportation system, a few rules might be leveraged to improve transportation options for seniors. For example, the rules which dictate how seniors are forced to stop driving could be improved to reduce the stigma of driver cessation and encourage a more gradual process (MacDonald & Hébert, 2010). Under the current rules in

BC, a senior someone still driving at the age of 80 receives a notice in the mail from ICBC, notifying them of their need to report to a medical professional authorized to conduct the driver's medical exam (Driver's medical exams, n.d.). Based on the results of this exam, less than 2% of seniors in BC are then referred to a further test at an ICBC office (Office of the Seniors Advocate, 2017). Changing the rules might include the implementation of graduated de-licensing, complemented by workshops and resources to help drivers explore other options (MacDonald & Hébert, 2010; Mezuk & Rebok, 2008). This would be feasible to do, requiring implementation from ICBC direction from the Province, and collaboration with TransLink and senior-serving nonprofits, could be done with moderate resources in a medium amount of time, but would meet considerable public outcry.

Other rules of the system that could be leveraged include looking at current traffic laws to better protect seniors, particularly pedestrians. For example, restricting driver right turns on red lights would increase the safety of pedestrians (Retting, Nitzburg, Farmer, & Knoblauch, 2002), as would giving pedestrians head starts at lights through leading pedestrian intervals, and providing more time to cross the road with crosswalk countdowns (Sayed, 2012). These changes could all be implemented by municipalities, would require relatively minimal resources, and could be done relatively quickly. Restricting right turns on red lights would see the most public indignation, but nevertheless, all of these rule changes are feasible. Changing the rules of the

road through implementing transit signal priorities and dedicated bus lanes would improve efficiency and reliability of bus routes (Chang, Collura, Dion, & Rakha, 2003). These time savings could be used to allow for increased passenger loading time, ensuring seniors and others with limited mobility are safely seated. More efficient and reliable service would also encourage more people of all ages to take transit, thus justifying more transit service, and more frequent service, creating a positive feedback loop (Boarnet et al., 2011; Meadows, 1999). Implementing transit signal priorities and dedicated bus lanes would require cooperation from municipalities, TransLink and the Province, would require minimal resources, and could be done in a relatively short amount of time. Inevitable public opposition means doing so is feasible, but not very feasible.

Changing the structure of the system can wield considerable power, and is thus leverage point four (Meadows, 1999). Meadows (1999) points that out that any system dependent on only one culture is bound to fail. In terms of transportation, this illuminates the fact that like most North American cities, Metro Vancouver's transportation system will fail seniors if it continues to be dependent on the car as the main way to get around (Munro, 2016; Turcotte, 2012). A change in the structure of a system tends to happen through a social revolution, or the introduction of a technology which forces it to change (Meadows, 1999). Looking back, it is evident that the invention of the automobile not only changed the structure of transportation

systems, it changed the structure of cities themselves (Newman & Kenworthy, 2011). Looking ahead, the technology of self-driving cars will not fundamentally change the structure our transportation system (Leslie, 2018). However, a social revolution which demands an end to the dominance of cars in cities and ensures transportation systems prioritize people walking, cycling, and taking public transit, has the power to really change the structure of the system (Meadows, 1999). Changing the structure of the system would require the cooperation and political will of TransLink, the Province, and municipalities, would take a considerable amount of time and resources, and would likely encounter considerable public opposition. Thus, it is not very feasible.

Leverage point three presents the opportunity to change the goals of the system. System goals tend not to be stated and may not even be obvious to people working within the system but are present nonetheless (Meadows, 1999). Like other cities' transportation systems, it could be argued that the goal of Metro Vancouver's system is to get people to work, primarily by car (Garrett & Taylor, 1999; Turcotte, 2012). Building a truly senior-friendly city will require looking beyond commuting trips, to include trips for those no longer working. This would likely lead to a focus on connecting more destinations within neighbourhoods, reachable by walking, cycling, and public transit (Pugh, 2017). Looking specifically at the goals of the public transit system, most systems either have the goal of providing a high degree of frequency to move the

most people, or to increase coverage area for better access (Walker, 2008). Serving seniors effectively will require more focus on the latter. However, it is worth considering whether or not a transit system could simultaneously achieve both goals. To do so may require a paradigm shift, leverage point two (Meadows, 1999). Changing the goals of the system is not very feasible, requiring cooperation from the Province, municipalities, and TransLink, would take a long time, would require moderate resources, and would be encountered by significant public opposition.

A true paradigm shift has the power to transform a system (Meadows, 1999). Dictating the goals of the system, there are multiple paradigms operating within the Metro Vancouver transportation system. First, the contributions and needs of working people are considered of primary importance (Uluorta, 2009). Second, that the motor vehicle is the best way to get around, because it is the fastest mode (Banister, 2008). Third, that it is more important to have a lot of space and larger houses than being close to services and amenities (Boarnet et al., 2011). Of the three paradigms, achieving a paradigm shift as to the superiority of motor vehicles is likely the most feasible, as policies and infrastructure improve the experience of using other modes of transportation and encourage a societal shift in thinking (Quora, 2017). Continuing this trend will require the cooperation of municipalities, TransLink, ICBC, the Province and Federal government, will likely take a considerable amount of time, will take considerable resources (although not as many as a continuance of the status quo of building infrastructure for cars), and

will continue to meet public resistance. While there is some evidence that this shift is occurring within younger generations (Bomey, 2016), it is unlikely to occur quickly enough to improve the transportation system for seniors. Changing the paradigms of density within the region and the emphasis on getting to work, will require a huge societal shift and will take a long time, and will require fairly significant resources. Thus, these paradigm changes are not very feasible.

The twelfth, and final leverage point is defined by Meadows (1999, p. 19) as “the power to transcend paradigms”, or to realize that a paradigm is only that, a way of seeing the world. Transcending paradigms would be to rise above all paradigms, and realize they only confine solutions, and that there are endless ways to do something (Meadows, 1999). This would require overcoming the paradigms that dictate how cities are designed to realize there are endless ways to do this, and that the primary importance may not be getting people to work, from spread-out homes, in cars. This is very unlikely to be a feasible leverage point to improve transportation options for seniors in Metro Vancouver.

**Table 1: Meadows’ (1999) leverage points in the context of Metro Vancouver’s transportation system**

<b>Leverage point, in order of increasing effectiveness according to Meadows (1999)</b>	<b>Options within Metro Vancouver’s transportation system</b>	<b>Feasibility</b> , based on time required, potential for public backlash, resources required and number of agencies who need to be involved	<b>Implementation Stakeholders</b>
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12. Constants, parameters, numbers, such as taxes and subsidies	Free transit for seniors	Feasible	Province of BC and TransLink
	Further subsidies to volunteer ride programs	Feasible	External funders and operators of volunteer ride programs
11. Increasing buffers and stabilizing stocks, or providing more of a back-up stock in order to increase reliability and availability	Increasing HandyDART fleet	Somewhat feasible	TransLink, Province of BC and municipalities
	Increasing bus fleet	Somewhat feasible	TransLink, Province of BC and municipalities
	Adding accessible vehicles within taxi, ride-hailing and volunteer ride fleets	Feasible	Passenger transportation board, taxis and ride-hailing companies, and operators of volunteer ride fleets
	Increasing availability of volunteer ride programs	Feasible	External funders, operators of volunteer ride programs
10. Structure of stocks and flows and how they interact, or the design of a system and the physical structures within it	Transit Oriented Development and inclusionary zoning	Feasible	TransLink, municipalities, developers
	Improving the built environment	Feasible	Municipalities, ICBC, Province and TransLink
	Not adding any more capacity for cars	Not very feasible	Province, TransLink and municipalities
9. Length of delays within feedback loops, or increasing a system's adaptability	Building now for an aging population which will be driving less	Not very feasible	TransLink, Province, municipalities, ICBC, health authorities, Federal government

<p>to a change in demand on the system</p>			
<p>8. Using negative feedback loops to temper demand of transportation modes</p>	<p>Increasing the cost of driving to better reflect its true cost through road pricing</p> <p>Taking away space from cars by reducing amounts of parking and re-designing streets to have fewer car lanes</p>	<p>Not very feasible</p> <p>Not very feasible</p>	<p>Province, municipalities, TransLink, Passenger Transportation Board, ICBC</p> <p>Municipalities, Province, TransLink</p>
<p>7. Using positive feedback loops to generate more demand of transportation modes</p>	<p>Wider, accessible sidewalks and more protected bike lanes</p> <p>More frequent, senior-friendly public transit</p> <p>Senior-friendly shuttles</p>	<p>Feasible</p> <p>Feasible</p> <p>Very feasible</p>	<p>Municipalities, cost-sharing with TransLink, ICBC, health authorities and Province</p> <p>TransLink, funding from Province</p> <p>TransLink, municipalities, health authorities, Province, senior-serving agencies</p>
<p>6. Providing new information access points to change people's behaviour</p>	<p>Transit and travel training</p> <p>Seniors Transportation Hotline</p>	<p>Very feasible</p> <p>Very feasible</p>	<p>TransLink, non-profit senior-serving agencies, BEST</p>

	Increasing communication between transportation policymakers	Feasible	Seniors on the Move partners, TransLink, ICBC, health authorities  Municipalities, TransLink, health authorities, Province, ICBC, non-profit senior-serving agencies
5. Changing the rules of the system, such as laws and policies	Restricting right turns on red lights, implementing leading pedestrian intervals, increasing pedestrian countdowns	Feasible	Municipalities
	Increasing right of way for transit vehicles	Feasible	Municipalities, Province, TransLink
	Changing the process of Driver Medical Exams for those over the age of 80	Feasible	ICBC, health authorities
	Introduce Graduated De-Licensing	Feasible	ICBC, Province, health authorities
4. Changing the structure of the system	Prioritizing people walking, cycling and taking transit over those driving	Not very feasible	Province, municipalities, TransLink
3. Changing the goals of the system	From a focus on commuting trips to include trips for those not working	Not very feasible	Province, TransLink, municipalities

2. Paradigm shifts	Needs of working people are no longer of primary importance  Cars are no longer the best way to get around  Large houses and space are no longer more important than walkable communities	Not very feasible  Not very feasible  Not very feasible	Society  Society  Society
1. Transcending paradigms of designing cities for working people with large homes and cars	Realizing that there are endless ways to look at anything, including the transportation system	Not very feasible	Society

## 9.0 Recommendations

Using Meadow's (1999) analysis of where the most effective leverage points exist, and examining their feasibility in the context of Metro Vancouver's transportation system, based on the number of stakeholders needed, the time and resources required, and the likely presence of public backlash, the following changes are recommended to make Metro Vancouver's transportation system more senior-friendly. The recommendations are in the order of most feasible, to least feasible.

**1. Continue developing and expand transit training to reach more seniors.** Training for all forms of sustainable transportation for seniors, such as mobility management sessions and individualized transportation planning, will help older drivers make informed decisions and better cope when they do stop driving (Gustafsson et al., 2012; Mulley & Nelson, 2016). These should be offered and marketed through a partnership between TransLink, ICBC, health authorities, Better Environmentally Sound Transportation (BEST), senior-serving non-profits and community stakeholders.

**2. Increase coordination and information flows between all transportation stakeholders and decision-makers, including the Province of BC, municipalities of Metro Vancouver, ICBC, health authorities, senior-serving non-profit organizations and TransLink.** The development of the Seniors Transportation Hotline and Hub will work towards this goal, as data collected from calls to bc211 about seniors and transportation will be analyzed and sent to stakeholders, including TransLink, ICBC and Vancouver Coastal and Fraser Health authorities (Williams, 2018). Better coordination and cooperation between HandyDART, the Province, and the health authorities will help to improve the customer experience (Marx, Davis, Miftari, Salamone, & Weise, 2010). Collaboration within the health system and ICBC could lead to the formation of mobility teams of social workers, licensing authorities, rehabilitation

professionals and doctors, who could provide a comprehensive, personalized approach to transportation planning for seniors (Thakuriah et al., 2011; Webber, Porter, & Menec, 2010).

**3. Require taxi and regulate ride-sourcing companies (when approved) to have a greater percentage of accessible vehicles on the road at one time to increase their availability and implement a tax on all ride-sourcing trips** (Moran & Lasley, 2017; Ward, 2017). This surcharge should be used towards a fund which improves sustainable transportation, including senior-friendly initiatives. Like the current taxi-saver program, discounted trips for seniors, those with limited mobility, or low-income can be provided through an agreement with ride-hailing companies and either the Province or TransLink. While these measures will not result in a large systems change, they would be easy to enact, as the Passenger Transportation Board controls all licensing of taxi and ride-hailing companies and their fleets (Moran & Lasley, 2017). While there would likely be some public discontent over the tax, it would likely be overshadowed by the strong public desire for ride-hailing to come to Metro Vancouver (Yuzda & Little, 2017). The tax would help balance the effect of venture capital-subsidized ride-sourcing prices competing for mode-share with the public transit system, when ride-sourcing companies are approved in BC by the Passenger Transportation Board (Bliss, 2017; Reuters, n.d.), and will create positive feedback within other modes with the invested funds (Small, 2017).

**4. Increasing availability of volunteer ride programs.** More funding will be required from the Province and/or Ministry of Health, directed towards recruiting more volunteer drivers, covering the operational costs of more rides, and establishing a coordinated network of volunteer ride providers to increase scheduling efficiency, best practices and promotion (Best Practices in Volunteer Driver Programs, 2017).

**5. Implement more senior-friendly shuttles to bridge the gap between HandyDART and conventional transit.** If planned and marketed properly with community input, these will remove some of the burden on oversubscribed volunteer ride programs and HandyDART services (Nelson et al., 2010). These could be operated by TransLink or by community partners, and funded by a variety of sources, including all levels of government.

**6. Change the process of Driver Medical Exams for those over the age of 80** (Rudman et al., 2006). In 2016, only 960 seniors (less than 2%) of the 65,810 seniors over 80 who were required to get a Driver's Medical Exam Report from doctors or nurses practitioners, were referred for further testing (Office of the Seniors Advocate, 2017). With a \$75 minimum cost per exam (many medical professionals charge more) (Driver Medical Fitness Information for Medical Professionals, n.d.), this system cost at least \$4,935,750 to conduct the exam for 65,810 seniors in one year. With only 960 drivers being referred for further testing, this averages out to \$5141.40 per driver referred, an expensive system. Family doctors conducting these reports are

reluctant to fail patients due to a fear of jeopardizing their relationship, taking away their primary form of transportation, and a lack of education about the driver cessation process (Rudman et al., 2006). Shifting this role to occupational therapists or rehabilitation professionals may be a solution (rehabinkmag, 2018; Rudman et al., 2006). More education on the implications of driver cessation and alternatives to driving for all medical professionals and better assessment tools will also be necessary (Betz et al., 2017; Munro, 2016; rehabinkmag, 2018). These changes would need to be implemented by health authorities and ICBC.

**7. Adapt the built environment to be senior-friendly.** In a seniors' mobility concept mapping of 200 stakeholders in the U.S., improving the safety of built environment was rated as having the most potential positive impact, but the feasibility of doing this was rated much less favourably (Anderson et al., 2014). Making the built environment senior-friendly will need to include making more complete streets with traffic calming and continuous, fully accessible, wider sidewalks and benches, washrooms, and bus shelters (Anderson et al., 2014), and more networks of protected bicycle lanes (Pucher & Buehler, 2017), all integrated with more senior-friendly public transportation options (Burkhardt, 2007). Doing so will require greatly increased coordination and collaboration between authorities, and require financial contributions from the Province and health authorities, rather than local governments being solely responsible (Anderson et al., 2014; Masotti, Fick, & O'Connor, 2010).

**8. Implement graduated de-licensing, based on ability** (MacDonald & Hébert, 2010).

This should be done in conjunction with increasing supports, both emotional and practical, for drivers to consider driving less, or not at all (Liddle et al., 2008). Supports for driver cessation, such as workshops, should also be developed, implemented and marketed with community and non-profit stakeholder involvement (Levasseur et al., 2016). This will need to be taken on primarily by ICBC, but will require support from the Ministry of Transportation and Ministry of Health, among other stakeholders. Precedent has been set with the graduated licensing program for new drivers (Graduated licensing, n.d.).

**9. Increase integrated, senior-friendly land use and transportation planning.** A

common saying in transportation planning is that the best transportation plan is a good land use plan (City of Vancouver, 2012). To meet the needs of an aging population, more options need to be provided for those who want to downsize and move to more walkable communities (Boschmann & Brady, 2013). For the majority who want to age in place in the suburbs, retrofits will need to include more mixed land use and increased amenities within walking distance (Boarnet et al., 2011; Boschmann & Brady, 2013). Doing this will require a complete revisiting of single-use and single-family zoning practices (Qureshi & King, 2015), which can be done by municipalities. It will also require collaboration between city planners, transportation planners, developers, and engineers, among others. While the current political climate may be not be

extremely receptive to a change in density and mixed land-use, a rising YIMBY (Yes In My BackYard) movement from younger generations (Kalinowski, 2017) in conjunction with seniors looking to downsize and access good transportation options, may provide the necessary political backdrop to make this change.

**10. Change the rules of the road to prioritize vulnerable road users.** Of all pedestrians, seniors experience the most fatalities in motor vehicle crashes. Pedestrians and cyclists are generally able to survive being hit at 30 km per hour, but have an 80% risk of dying at 50 km per hours. Changing the default speed limit from 50 km per hour to 30 km per hour on non-arterials, with corresponding traffic calming measures to ensure limits are abided by, will dramatically increase the safety of older adults (Kendall, 2016). Other measures to improve safety include establishing the right of way of pedestrians at intersections through leading pedestrian intervals, increasing the time given to pedestrians to cross to accommodate a range of abilities, providing more protected left turns for cars to reduce conflicts, and restricting or banning right turns by red lights, as outlined in the City of Vancouver's Pedestrian Safety Study (Sayed, 2012). These changes could be implemented by municipalities, or the Province of BC. Some of these changes would be more feasible from a political standpoint than others, such as installing leading pedestrian intervals or increasing the time allotted to pedestrians to cross the street at signalled intersections.

## 10.0 Conclusion

The cost of collisions involving older drivers is estimated to be \$800 million annually in Canada (AARP, 2017). Looking ahead to a country which is already extremely aged, 40% of crashes in Japan were caused by those over 75 (Ariga & Matsuhashi, 2016). By reviewing the literature, the findings from the Seniors on the Move Seniors Advisory Committee, and the digital stories from South Vancouver Neighbourhood House, it is clear that there a range of improvements are needed to make Metro Vancouver's transportation system ready for its aging population. By comparing the local findings of the Seniors Advisory Committee and the South Vancouver Neighbourhood House to the research done elsewhere, it is also evident that the adjustments needed in Metro Vancouver are very similar to that which needs to happen in other cities in North America. This is because the vast majority of cities in North America were built around the car (Munro, 2016).

Metro Vancouver has always been one which prides itself on its sustainability, city-building and multiple ways to get around (Hutton, 2011). This provides a solid foundation for the region to build upon and adapt in time for 25% of the Provincial population aged over 65, in 2041 (Population Projections, British Columbia and Sub-Provincial, n.d.). If Metro Vancouver truly wants to be regarded as one known for its planning (Hutton, 2011), its transportation

stakeholders and decision-makers will need to embrace the opportunity to meet the needs of seniors. By examining potential improvements through a systems lens, we can see which improvements will have the most impact (Meadows, 1999).

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Appendix 1: Focus Group Questions from the Seniors on the Move Seniors Advisory Committee, from October 26, 2016

**Sharing our Stories: Experiences with Transportation**

*2 students are matched with 2 seniors for seniors to share their stories. Stories can be about their own vehicles or friend/families, public transport (TransLink, HandyDART), Taxi's, private or non-profit transportation providers. Try to understand where the barriers are. Ask not just about logistics: find out how things makes them feel, what they wish could be different, what they enjoy, what gets in their way. Your job is to listen and learn, so don't be afraid to ask "Why?".*

**Focus Group Discussion A: Transportation needs of seniors**

*At a table with a group of seniors, the students should facilitate a discussion about some of their transportation needs: Where do they need to go? why do they need to go there? What does it mean to not be able to get there? . This discussion should be informed by a literature review about seniors transportation and validate that transportation is a critical contributor to isolation.*

**Focus Group Discussion B: Barriers that prevent seniors from getting from origin to their destination**

*At a table with a group of seniors, the students should facilitate a discussion about some of the barriers seniors face. This discussion should be informed by a literature review about seniors transportation and prioritize the 5 As. (Availability, Acceptability, Accessibility, Adaptability, Affordability)*