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Integrated Urban Mobility for Our Health and the Climate: Recommended Approaches from an Interdisciplinary Consortium

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Abstract: Background: The purpose of this paper is to suggest an approach to aid with the creation of an interdisciplinary team and evidence-informed solutions addressing the urban mobility challenges facing many communities. Methods: We created a local Urban Mobility Consortium with experts from different disciplines to discuss the development of healthy, accessible communities, electrification, ride-sharing, and overarching issues related to urban mobility. A workshop and survey data collected during COVID-19 are presented in this paper. Results: Several evidence-informed recommendations are provided. Broadly, these were: (1) support the creation and development of accessible and safe active-transportation infrastructure; (2) incentivize and prioritize the use of active, public, and shared transportation over use of personal vehicles; (3) ensure connectivity of active transportation infrastructure with major destinations and public transportation options; (4) work towards electrification of personal and public transportation; and (5) work across siloes to improve integrated mobility to impact climate and health related outcomes, and enhance overall efficiency. Conclusions: An integrated approach is needed to improve mobility, access, and environmental impact. This needs to be carried out in the local context and requires government and non-governmental leadership.

Keywords: transportation; healthy cities; greenhouse gas emissions; multi-disciplinary



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1. Introduction

The issue of optimizing urban transportation for improved efficiency has been studied for decades by engineers and city planners. However, traditionally, the definition of transportation has been narrow, leading to the creation of “car-centric” communities, where cars (or automotive vehicles) are prioritized over people. This car-centric approach has made our communities more dangerous. According to data from the World Health Organization, the number of road traffic deaths has reached 1.35 million, annually; it has also become the number one cause of death for children and youth [1]. While there is variability between high, middle, and low-income countries, the burden is consistently borne by pedestrians and cyclists. Importantly, the increasing size of personal use vehicles (e.g., pick-up trucks and sport utility vehicles) has made injuries more severe and increased the risk of serious injuries, such as brain trauma [2]. Unfortunately, these vehicles are increasing in prevalence on our roads, particularly in North America [3,4]. Programs such as Vision Zero are supported by many municipalities; however, investments are rarely sufficient to meet the needs of communities, and traffic fatalities remain stubbornly high.

Efforts to make our roads safer for pedestrians and cyclists are partially responsible for an increase in active transportation [5]. This is important because transportation is responsible for a large portion of greenhouse gas emissions. Data from the United States

Environment Protection Agency indicate that the transportation sector is responsible for the largest proportion of greenhouse gas emissions (29%) [6]. Data from Canada suggest that greenhouse gas emissions related to transportation have increased by 27% in the past decade, and that this is at least partly due to the fact that the size of personal vehicles has increased [7]. Not surprisingly, this increase in emissions is associated with significant detriments to health. In a comprehensive analysis of global data, it was estimated that vehicle tailpipe emissions led to 385,000 (95% CI, 274,000–493,000) premature deaths in 2015 [8].

Mobility in our communities is critical for access to services, stores, healthcare, and social activity, across all ages and abilities. However, current transportation systems do not adequately cater to those without access to a personal vehicle; in fact, they encourage the use of a personal vehicle. This has led to a situation that is detrimentally affecting the health of our planet and people. A systems approach that is interdisciplinary and addresses sustainable, accessible, and efficient urban mobility is needed. The purpose of this paper is to provide a suggested approach to creating an interdisciplinary team and evidence-informed solutions to aid in addressing the urban mobility challenges facing our communities.

2. Suggested Approach

2.1. Urban Mobility Consortium: Creating a Local Interdisciplinary Network

An interdisciplinary human-centered approach is needed to address current urban mobility impacts. This requires multi-sectoral government involvement (Figure 1). Thus, we endeavored to create a local ad hoc Urban Mobility Consortium (UMC) led by SD, a human health and exercise scientist with expertise in active transportation, e-bikes, and chronic disease prevention, and DH, a civil engineer with expertise in sustainable cities, energy systems, transportation, and greenhouse gas emissions. The first step in developing the UMC was to apply for funding to host an event that brought multiple stakeholder groups together. We received funding from the Institute of Community Support, Planning and Dissemination grant program through the Canadian Institutes for Health Research.

Funds supported a one-day summit entitled “Improved Transportation: Moving Together” in October 2019. Four panels were scheduled, each with a researcher and/or a government stakeholder serving as the moderator. These panels were: Healthy Inclusive Cities, Electrification and Automation, Role of Ridesharing, and The Big Picture. Audience members engaged in discussion with the panels, and with one another, throughout the day, via panel sessions, lunch, and breaks. This event drew over 100 registrants from the local community, local and regional government, and relevant stakeholder groups (not for profits and private sector).

A report was developed and circulated in December 2019 outlining the current challenges, equity and access issues, five-year goals, and a future vision that evolved from each panel. The next step was to bring people together to create a working group focused on various high priority aspects of urban mobility. However, COVID-19 hit in March 2020, and the landscape of urban mobility drastically changed overnight. Nevertheless, the UMC created a network that has worked together on several projects over the past year, including one looking at the local impacts of COVID-19 on commuting changes and choices (see below).

In order to ensure continued collaboration across disciplinary siloes, it is important to create an organized group. Thus, our next steps are:

- To create an ad hoc UMC Committee: A formal committee will be created with the governance requiring representation from researchers, government, and stakeholder groups from various sectors, levels, and disciplines, in order to ensure continued collaboration and to support local efforts to improve urban mobility. The committee will create a vision, mission, and annual plan to ensure that contemporary, evidence-based solutions are being prioritized and addressed.

- Working Groups: The committee will create working groups based on current priorities and feasibility. These will be driven by the local context.
- Funding: The committee will work to acquire funds for projects, and support other groups with their applications. As the UMC grows, funding for a staff member will become critical.



Figure 1. Government Influence and Roles of Various Ministries in an Integrated Urban Mobility Approach.

A key aspect of the UMC will be its ability to cross political jurisdictions while connecting with relevant agencies and stakeholder groups. An apolitical group such as this is necessary to ensure continuity of the work as new governments come into power.

2.2. COVID-19 Case Study

Here we present a case study highlighting the benefits of the UMC. When COVID-19 hit North America, the sudden change in urban mobility patterns created uncertainty regarding daily traffic. Due to the unprecedented nature of the pandemic and the drastic

changes to commuter habits, it was difficult to understand what re-opening, or return to work commuter patterns, would look like. With this in mind, we partnered with our local municipal government to explore commuter habits and intentions upon return to work. We created a survey in consultation with government staff from various departments (public transit, roads department, active transportation committee) through the UMC network, and we launched the survey in the fall of 2020 after receiving research ethics approval from the Ontario Tech University Research Ethics Board. All participants provided informed consent. Recruitment was carried out via online posts through social media, newsletters, and email in the local community.

Over 220 adults completed the online survey. Of these, 68% were full time post-secondary students, and 86% indicated that the University campuses were their primary commuting destinations prior to the pandemic. The results of this study indicated that prior to the pandemic, the average commuting distance of this sample was 19 km/day (range: 0–110 km), with 59% of the sample indicating that they commuted daily and only 4% of the sample commuting 0 times per week. The primary mode of transportation was a personal vehicle (47%). Figure 2 shows the transportation modes used.

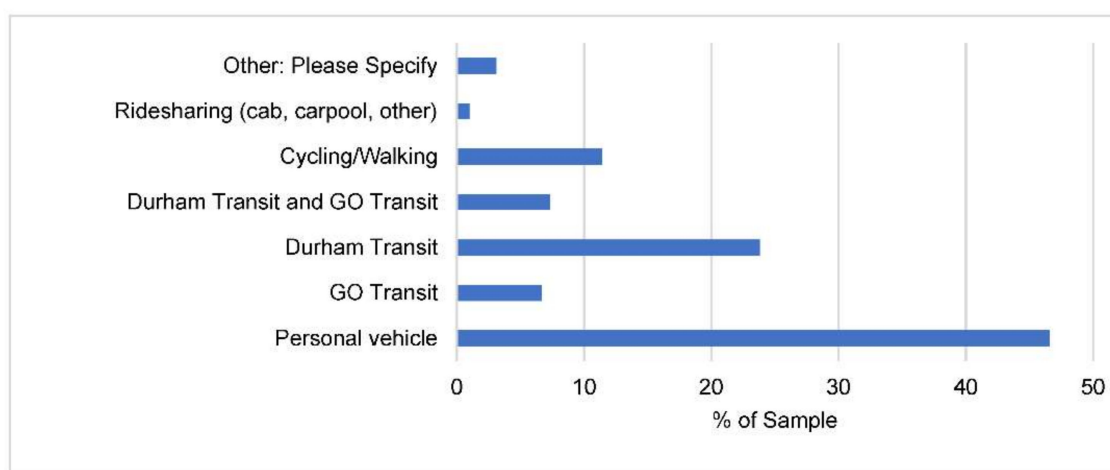


Figure 2. Modes of Transportation PRIOR to the Pandemic.

Due to the pandemic, 81% of the sample indicated that their primary daily destination changed. The number of days that participants in the sample commuted changed such that 43% were now commuting 0 days per week. Figure 3 shows the number of days the sample was commuting at the time of completing the survey.

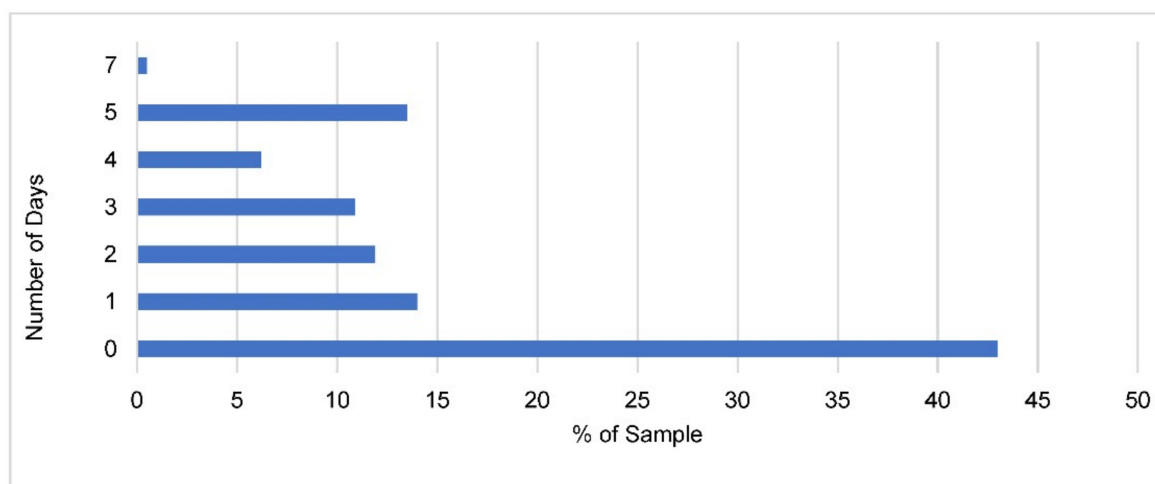


Figure 3. Number of Days Commuting DURING the Pandemic.

Over 20% of the sample intended to change their mode of transportation (10%) or were unsure if they would use the same mode of transportation (11%) once they returned to normal activities after the pandemic. Of these, 60% indicated that they intended to change to the use of a personal vehicle. Several individuals indicated concerns with the use of public transit; crowding on vehicles ($n = 108$) and cleanliness/sanitation ($n = 106$) were the main concerns. Participants also indicated concerns with cycling and walking. For cycling, the main concerns were a lack of cycling lanes ($n = 24$), safety of intersections ($n = 20$), traffic ($n = 19$), the poor condition of sidewalks ($n = 18$), and a lack of secure bike racks ($n = 17$). For walking, the main concerns were safety of intersections ($n = 45$), touching push buttons ($n = 42$), the poor condition of sidewalks ($n = 33$), and traffic ($n = 23$). Finally, when asked whether commuters would use ridesharing apps or bike share programs, 72% and 79%, respectively indicated that they were very unlikely or unlikely to use them. A report with these data was submitted to the University and municipality for planning purposes.

Of note, this survey-based study may have limited generalizability, given the small sample size from a unique geographical region. It is also subject to sample-selection bias and, thus, may not be representative of the entire community being studied. Nevertheless, this case study highlights the importance of having a UMC so that researchers can quickly work with partners to provide meaningful data to municipalities, and so that established networks allow work that would otherwise be too taxing for already overburdened municipal staff to take on.

3. Results and Recommendations

Based on the multi-stakeholder workshop described above, we provide several recommendations and evidence-based strategies to create a sustainable urban mobility plan (Table 1). The budget realities and contexts of individual communities may render some suggested strategies impractical, premature, or unnecessary; however, communities who have declared a climate emergency should prioritize as many strategies as possible to accomplish their emissions targets, as well as to improve the health and well-being of their residents. As highlighted in the case study above, this pandemic has provided an opportunity to spark changes to urban mobility patterns; however, appropriate supports are immediately needed to ensure this opportunity is not missed.

Table 1. Recommendations and Benefits of Sustainable Transportation.

Recommendation	Intended Transportation Effects	Health and Environmental Effects
Support the creation and development of accessible and safe active transportation infrastructure.	Increase in the number of residents who choose to participate in active transportation will lead to a reduction in personal vehicle use.	
Incentivize and prioritize use of active, public, and shared transportation over use of personal vehicles.	Increase in the number of residents who use active or public transportation will lead to a reduction in personal vehicle use.	Direct health benefits to the users of active transportation.
Ensure connectivity of active transportation infrastructure with major destinations and public transportation options.	Connectivity is a significant barrier to active transportation and public transportation use. Thus, work should be prioritized to facilitate greater uptake of both modes of transportation. This will lead to a reduction in personal vehicle use.	Decrease in GHG associated with reduced number of vehicles. Improved air quality associated with reduced particulate emissions.
Work towards low-carbon, personal and public transportation, e.g., electrification and hydrogen.	A higher proportion of low-carbon vehicles will lead to a reduction in greenhouse gas emissions from personal vehicles and public transportation.	
Work across siloes to improve integrated mobility to impact climate and health related outcomes.	Equitable, barrier free, eco-friendly mobility.	

3.1. Recommendation 1. Support the Creation and Development of Accessible and Safe Active Transportation Infrastructure

Suggested Strategies

- Create policies and practices that prioritize people over cars. Some of these can be revenue generating [9].
 - i. Only allow for creation of complete streets; that is, do not allow for new roads to be developed without the inclusion of appropriate sidewalks, bike lanes, or multi-use pathways [10–13].
 - ii. Construction sites, delivery vehicles, service vehicles, or personal use vehicles should not be allowed to obstruct sidewalks or bike lanes. Heavy fines should be introduced for such offenders [14–16].
 - iii. Snow clearance and maintenance of sidewalks, bike lanes, and multi-use pathways should be prioritized over roads [17–20].
- Create high quality infrastructure that encourages active and public transportation.
 - i. Painted lines should not be considered bike lanes as they are not safe and do not encourage active transportation [21–23].
 - ii. Increase awareness related to active transportation infrastructure in the community [24–29].
 - iii. Prioritize active and public transportation infrastructure to major destinations along major routes, such as train stations, universities, hospitals, etc. [30–32].
 - iv. Maintain infrastructure regardless of initial usage [20,33,34].
 - v. Create bike parking infrastructure to minimize theft and encourage cycling to local destinations [35–37].
- Include a diverse group of individuals from your community in planning.
 - i. Apply an age-friendly lens to transportation planning and include older adults, as well as advocates of vulnerable older adults such as representatives from dementia, elder abuse, and ageism groups [38–40].
 - ii. Aim to be barrier-free for those with physical, intellectual, and sensory disabilities by including representatives with disabilities or advocates from disability groups [41–43].
 - iii. Include women, individuals from the LGBT-Q community, and individuals from other under-represented groups in conversations to ensure their needs and safety concerns are appropriately addressed [44–47].

3.2. Recommendation 2. Incentivize and Prioritize Use of Active, Public, and Shared Transportation over Use of Personal Vehicles

Suggested Strategies

- Remove certain vehicles from the roads to improve air quality and health [48–50].
- Provide incentives for purchasing and using e-bikes for short trips [51–53].
- Provide incentives for leaving the car at home [54–57].
- Increase parking costs at all municipal facilities [58–61].
- Make public transportation free of charge [62–64].
- Provide discounted parking fees to those who carpool [65–67].
- Shift to levying charges per vehicle-kilometers travelled (VKT), starting with delivery vehicles [68].
- Provide real-time monitoring and communication of greenhouse gas emissions by the community, with data from the transportation sector delineated [69–71].

3.3. Recommendation 3. Ensure Connectivity of Active Transportation Infrastructure with Major Destinations and Public Transportation Options

Suggested Strategies

- Develop an integrated transportation system.

- i. Integrate train and bus stations with active transportation to ensure that individuals are not forced to use a personal vehicle to get to major public transportation hubs (first mile, last mile) [72–74].
- Increase connectivity throughout the community and through well-known routes. This can include the creation of overpasses and bridges for cyclists and pedestrians so that they do not have to wait at lights or cross busy intersections [75–77].
- Do not have bike lanes or sidewalks come to abrupt ends, forcing commuters onto the road [78,79].
- Ensure that all ride sharing companies operating in rural and urban communities are providing accessible options to residents [80–83].

3.4. Recommendation 4. Work towards Electrification of Personal and Public Transportation

Suggested Strategies

- Ensure charging stations are available throughout the community and have the capacity to deal with increasing demand [84–86].
- Provide financial incentives for parking of electric cars and bikes [87–89].
- Subsidize prices of electric cars and bikes [87–91].
- Electrify public transit vehicles, starting with the oldest vehicles in the fleet [92–94].

3.5. Recommendation 5. Work across Siloes to Improve Integrated Mobility to Impact Climate and Health Related Outcomes

Suggested Strategies

- Different levels of government need to work together to develop a systems level approach to ensure services and infrastructure across government levels and departments are inter-connected and are facilitating healthy, eco-friendly transportation options. This includes smooth transitions between active and public transportation [95–97].
- Put a price on carbon to reduce personal vehicle use:
 - i. Road tolls [98–101]
 - ii. High occupancy vehicle lanes [98–102]
 - iii. Parking fees [59,103–105]
- Connectivity and integrated planning need to be prioritized, particularly in new communities. This is critical for reducing personal vehicle use [106,107].
- Encourage multi-modal transportation that is equitable and barrier free. This is critical for ensuring that people of all ages, colors, income levels, and ability levels are able to move in their community [108–110].
- Integrated mobility can lead to household savings of CAD 8000 per year from reduced vehicle operation costs. Additional recommendations related to integrated mobility and climate impacts can be found here: https://shared.ontariotechu.ca/shared/faculty-sites/sustainability-today/publications/uoit_improved_transportation_2018.pdf (accessed on 5 November 2021).

4. Conclusions

Transportation (personal mobility and deliveries) is one of the most pressing complex issues facing metropolitan areas. Today, transportation emissions are one of the largest sources of greenhouse gas emissions, leading to detrimental climate and health outcomes. The placement and structure of communities are dictated by transportation. Congestion and fractured mobility services are one of the largest drags on the economy and detractors of well-being. Increasing the use of multi-modal transportation, and emphasizing active transportation, public transportation, and the electrification of transportation provide an opportunity to enhance the health of humans and broadly reduce environmental impacts. This can lead to a strengthened and more stable economy. It is time that we move towards an integrated mobility approach. This needs to be carried out in the local context and requires non-governmental leadership. Specifically, future research must design, implement,

and evaluate interventions that target an increase in use of active and public transportation in consultation with local residents, advocates, professionals, municipalities, and senior levels of government. A non-governmental approach is needed to ensure continuity of projects during changes in government and shifting government priorities.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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