Can we plan and design our built environment *for better health?*

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Preface

Through our Future Ready program at WSP, we recognize that changing climate, new technologies, a dynamic population and shifting resource consumption patterns are shaping our future, every day.

Everything we do as engineers, planners, scientists and designers of the built environment is for the use and benefit of people, to enable thriving communities. But how often do we think about the health implications and potential in our designs?

Through this research, we answer the question, "How could we design and plan our built environment for better health?"

As urbanization intensifies, autonomous vehicles become ubiquitous and new construction materials become available, new health risks will present themselves – but so too will new opportunities for re-imagining the way we design our built environment for better health.

We interviewed 13 experts from disciplines that influence our health in a variety of ways. From our own expertise in healthcare facilities, neighbourhood, housing, and active transport and transit planning and design, we have proposed new ways of planning and designing the built environment.

Many of our recommended changes will only happen with strong government regulation and cross-disciplinary collaborations. We hope that the contents of this white paper spark thoughts and inspiration, and provide the impetus for change. We are ready to be integral to this change, and to continue to seek evidence of how different ways of planning and designing the built environment can improve our health.

If you are interested in learning more about how to plan and design the built environment for better health, or in collaborating with us to do more, please contact me at Anna.Robak@wsp.com and I'll connect you with the right experts.

Thank you for your interest in improving Canadians' health through your work as an engineer, planner, scientist or designer of the built environment. We hope you find the information useful and we look forward to your feedback.

Anna Robak
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WSP Canada

How could we design and plan our built environment *for better health?*

Modern medicine has reduced the rate of acute disease, but chronic disease rates are on the rise. Our lifestyle choices are leading to more sedentary lifestyles, poorer eating choices, reduced social interaction, and greater anxiety. In making these lifestyle choices, we are significantly influenced by the design of our built environment. Engineers, planners and other shapers of our built environment have a significant role to play in reversing our declining physical and mental health.

TRENDS IN HEALTH

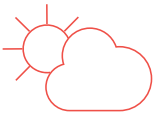
Over the next 15 years, alarming increases in rates of obesity, cancer and diabetes are forecast for Canada, including a tripling of resources required to treat and protect mental health. Researchers have found that up to a third of cases can be prevented through increased physical activity [1, 2, 3].

Our research has found that there are two main trends that will influence our health into the future:

1. Most important: **Climate**

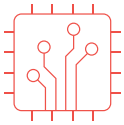
A changing climate and more volatile weather patterns will increasingly:

Prevent us from exercising outdoors when it's too hot, too stormy, or too wet + *damage our property, injure us, disrupt our lives, and increase stress levels through increased floods and forest fires.*



2. Most uncertain: **Technology**

The impact of changes in technology is highly uncertain, but it is expected that changes in technology will further alienate lower-income individuals, as their jobs are replaced by automation and Artificial Intelligence.



This means people will have less means to participate in physical activity, and are more likely to suffer from mental health problems, further exacerbating health challenges.

MOST AFFECTED CANADIANS

We are all in danger of declining health, but those at greatest risk of just about every chronic physical and mental illness have one or more of the following characteristics:

— Lower income
— Physical or intellectual disability
— First Nations or other minority
— Newcomer
— Older
— Live in a rural or remote area

These vulnerable people are set to make up a greater and greater percentage of Canadians (see section on vulnerable populations pages 15 and 16 for evidence). If we are to improve the health of Canadians, we must first and foremost protect the health of our most vulnerable populations.

DESIGNING THE BUILT ENVIRONMENT TO REVERSE NEGATIVE HEALTH TRENDS

To protect the health of Canadians, there is a lot we can do as designers and planners of the built environment. The literature indicates that the five most important built environment features that positively impact our health are:

Physical activity *is attractive and convenient, through neighbourhoods that have comfortable and attractive streetscapes for pedestrians nearby parks, shops, schools, employment opportunities, transit stops, active transportation corridors that are available year-round, and accessible paths from home.*

Consumption of more fruits and vegetables and less meat *is promoted, by eliminating food swamps and introducing urban gardens.*

Connection with nature *is promoted, through attractive green spaces and views of water.*

Social interactions *are ubiquitous, due to a wide network of attractive public realm features and facilities and the ability to work, live and play in the same neighbourhood.*

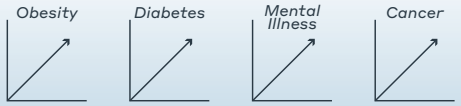
Homes *are healthy, well maintained and accessible.*

Although organizations may want to change the way they plan and design, economic forces will make those who invest more, less competitive – unless the right incentives exist. Government intervention is required to ensure developers, insurers, designers and institutions do enough to protect Canadians' health.

In the context of health, this intervention can take the form of mandating universal design, building materials, locations where building is not permitted,, reducing carbon emissions, operational requirements of post-disaster facilities, focusing developments on lower income communities, valuing the natural environment, and mixed use, or work / live / play zones.

Problems

Health Trends *(Outcomes)*



Influencing Trends

Most important
Likely to exacerbate health trends
Climate change volatility

Most uncertain
Likely to exacerbate health trends but could also mitigate
Technology

Solutions

Built environment solutions that can stabilize/reverse trends

1. Walkable neighbourhoods
2. Remove unhealthy food temptations
3. Built in social interactions
4. Green spaces and view of water
5. Healthy, accessible homes

Governance solution

Regulation and incentives required to promote healthy designs

In this paper, we uncover how the built environment influences our health, and how it can be designed differently to positively impact our wellbeing. The contents of this white paper are:

PAGE	TOPIC	CONTENT
4	**Health**	- The health lifecycle
6	**Trends**	- Diseases rising in prevalence, and their costs
8	**How the built environment affects our health**	- Physical activity - Air quality - Social cohesion, stress and mental health
14	**Planning for vulnerable populations**	- Who is more vulnerable and why? - Trends in vulnerable populations - Designing and planning for vulnerable populations
19	**Climate change and volatility**	- How does climate affect our health? - Trends in climate that will affect our health - Designing and planning for climate to protect our health
23	**Technology**	- How does technology affect our health? - Trends in technology that will affect our health - Designing and planning for technology to support our health
27	**The need for incentives**	- What kinds of incentives are required? - Why should government get involved?
29	**Summary**	- What you can do to enhance Canadians' health in the built environment

Health

The Health Lifecycle

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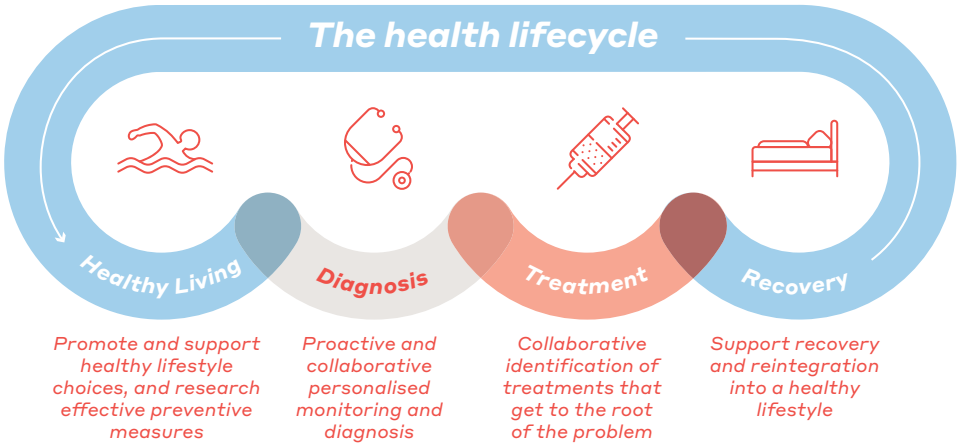
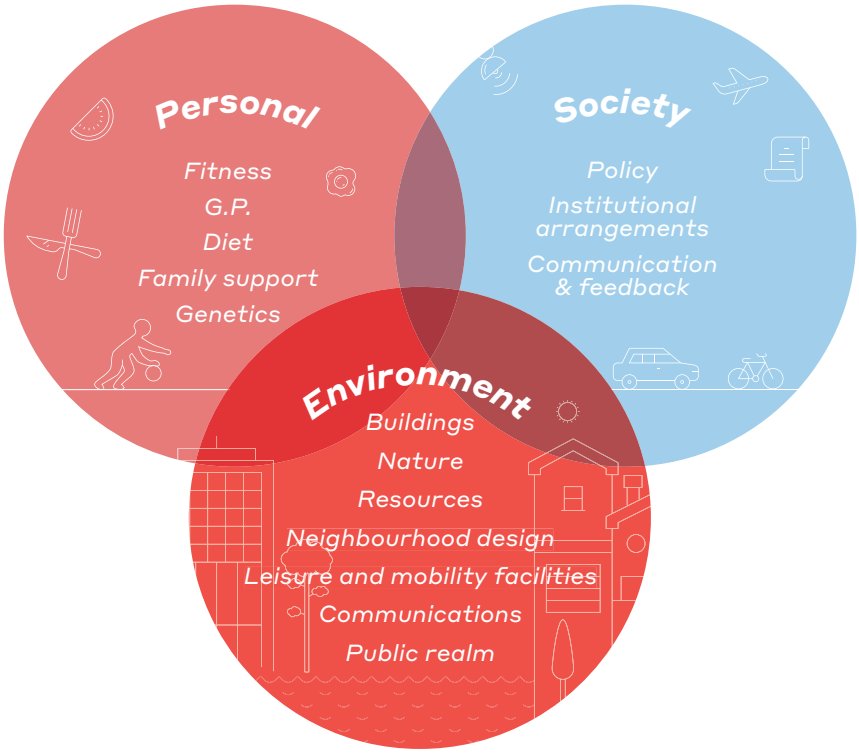
A NOTE ON THE HEALTH LIFECYCLE

When we talk about health, we're talking about the entire health lifecycle – from living healthy lifestyles through to taking preventive measures, diagnosing quickly and accurately, treating, and recovery and reintegrating into a healthy lifestyle.



There are personal, environmental, and societal factors that contribute the effectiveness of each part of the health lifecycle as shown below.



Trends

Diseases rising in prevalence, and their costs

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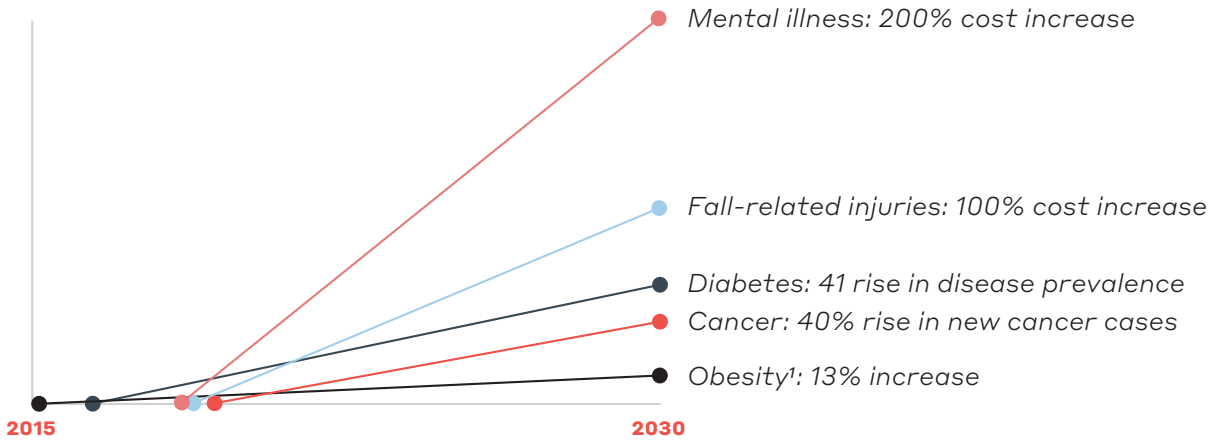
TRENDS IN HEALTH IN CANADA

For the first time in Canadian history, chronic disease rates outweigh acute diseases – and this trend is set to continue. Take a look at the trends for some of our most prominent illnesses and health conditions.



This paper explores what we can do, as designers and planners of the built environment, to stabilize or reverse these trends.

[1] Obesity isn't an illness, but it is one good indicator of physical activity levels and healthy food choices.

How the built environment affects our health

Physical activity
Air quality
Social cohesion, stress and mental health

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THE EVIDENCE: HOW THE BUILT ENVIRONMENT INFLUENCES OUR HEALTH

WHAT IS THE BUILT ENVIRONMENT?

The built environment "is the external physical environment where we live, work, study and play. It includes buildings, roads, public transit systems, parks, and other types of infrastructure." [9]

HOW DOES THE BUILT ENVIRONMENT AFFECT OUR PHYSICAL HEALTH?

Researchers have found that physical activity could cut out 22% of diabetes, 27% of ischemic heart disease, 20% of strokes [10], and 40% of Alzheimer's [11] cases. Together, physical activity, reduced obesity, and healthy food choices could cut out up to 25% of cancer cases [12]. Further, physical activity and healthy food choices are two of the eight factors that protect our mental health [13]. But how can the built environment influence our physical activity levels, food choices, and other aspects of our physical health?

PHYSICAL ACTIVITY LEVELS

Higher physical activity rates are closely associated with close and attractive outdoor facilities – whether for leisure or transportation. People living in neighbourhoods in which they can walk or cycle to school, work, or a good transit or active transportation corridor, get 15% more exercise on average [14]. And kids living less than 400m from a park are 60% less likely to be obese [15]. This means that the way we design neighbourhoods – the attractiveness and proximity of exercising-enticing amenities – plays a significant role in our physical activity levels.

Practical built environments can increase physical activity levels:

— ***Transportation systems.*** Provide attractive transit and active transportation facilities near home, school and work

— ***Public realm.*** Provide attractive parks, public realm features and walking paths that are interesting for all ages within 400m of homes

Practical built environment considerations for improving our air quality and respiratory health:

Transportation

- Provide attractive and convenient transit and active transportation facilities

Buildings

- Use low-carbon building and finishing materials, inside and out
- Use low-carbon and efficient heating and cooling technologies
- Design buildings to be well insulated and take advantage of natural light
- Indoor air quality ventilation
- More green spaces and street trees. Trees and other vegetation can soak up carbon produced. Choose vegetation that has a greater ability to do this.

Public Realm

- Trees and other vegetation can soak up carbon produced. Choose vegetation that has a greater ability to do this and add it to parks, streetscapes, buildings, and all aspects of the public realm.

HEALTHY FOOD CHOICES

Researchers used to think that a primary driver for unhealthy eating was due to the lower affordability or the greater distance of healthy foods from a person's home. But the evidence was inconclusive. What they have found is that the presence and availability of unhealthy foods appears to have a bigger influence on eating habits – whether the unhealthy food is near your home, school or work. Having fewer than five fast food outlets within a convenient distance reduces people's risk of obesity by 60% [16].

Practical built environments can entice healthier food choices:

— ***Remove temptations.*** Keep fast food restaurants and other unhealthy food choices further than 1.5 km from residences, schools and work, through design and planning.

— ***Enhance familiarization with healthy foods.*** Provide urban agriculture opportunities at schools, work, and close to home

AIR QUALITY

Polluted air can cause and aggravate respiratory and heart conditions, including cancer, and has been estimated to cause over 14,000 premature deaths in Canada per year [17]. While the good news is that many air pollutants have generally decreased in Canada over the past two decades [18], there are many ways in which our design of the built environment could help reduce it in further. Oil and gas, transportation, buildings and electricity together make up more than two-thirds of greenhouse gas emissions [19]. We'll focus on transportation and buildings, which drive much of the demand for oil, gas and electricity.

Transportation is one of the largest sources of pollution in Canada [20]. Building attractive and convenient transit and active transportation facilities helps to shift commuters and other travelers from single-occupant vehicles to shared ones, or ones that don't pollute at all, once produced.

Our choice of building materials and heating and cooling technologies also have a large impact on emissions, and therefore on air quality. This is because the building materials may use more energy to produce or transport, or emit chemicals into the air through their life. Heating and cooling technologies, too, can be more or less efficient at using energy that use carbon or other volatile chemicals. In fact, the choice of indoor finishing materials, heating and cooling technologies, and ventilation can affect indoor air quality to the extent that it can be two to five times worse than outdoor air quality – and in some extreme cases, pollutant levels are 100 times higher than outdoor levels [21]. This is critical, given 90% of our time is spent indoors [22].

While transportation systems and building design contribute to pollutant levels, trees and other vegetation can soak up carbon, helping to dampen or even reverse the effects of our built environment.

INJURY

Unintentional injuries were the fifth leading cause of death in Canada in 2011 [23]. Falls and transport-related injuries are the most relevant to our built environment. Falls cause 40% of all injuries [24]. While transportation accidents cause only 4% of injuries, they cause 21% of injury-related deaths [24].

Nearly two-thirds of seniors are injured by a fall each year [24]. 27% of these injuries occur while doing household chores, while 28% occur while walking [24]. We can't conclude that improvements to the built environment will reduce half of all falls, but we do know that age-friendly housing can help.

Injury also occurs when property, our natural environment, and the air we breathe is compromised, through storms, flooding and forest fires.

The rate of motor vehicle accidents and violent crime is also higher in neighbourhoods where there are more alcohol outlets [25].

Practical built environment ways we can reduce injury:

Buildings / Housing

- Provide age-friendly housing, including interior design, to support people of all ages and mobility levels
- Design ventilation systems to prevent intake of toxic outdoor air in the event of forest fires
- Restrict access to heights from which people can fall

Transportation

- Design complete streets by providing attractive, convenient, and SAFE public transit and active transportation facilities to reduce the number of vehicles on the roads and therefore reduce the number of motor vehicle crashes
- Restrict pedestrian access to fast-moving vehicles
- Provide blue lighting in stations

Public Realm

- Provide parks, more ubiquitous pleasing public realm features and other opportunities for activity close to home so that all ages and abilities can remain fit and agile

Prevalence of alcohol outlets

- Reduce the prevalence of alcohol outlets to reduce motor vehicle accidents and violent crime

Suicide is the leading cause of injury-related death in Canada [24]. Effects of the built environment on mental health are discussed in the following section. In addition to building an environment that will make people feel more connected, there are changes that can be made to prevent suicide. In public places, suicides occur most commonly in train stations, multi-storey car parks and other high buildings, and bridges [26]. And the most effective ways to prevent them are to restrict access [26]. However, there have been other innovative solutions. For example, blue light in train stations has been shown to reduce the rate of suicide at stations by 75% [27] – however, it is unknown if this change merely shifts the suicide to another location or prevents it altogether.

HOW DOES THE BUILT ENVIRONMENT AFFECT OUR MENTAL HEALTH?

The Government of Canada has identified eight factors that protect our mental health [13] – all of which can be influenced to some degree by the built environment. The linkages for each of the eight factors to the built environment is described below:

1. ***Healthy diet.*** Prevalence of unhealthy food outlets increases consumption of unhealthy foods
2. ***Physical activity.*** Proximity of attractive places to cycle, walk, and play increases activity levels
3. ***Sleep.*** Increased physical activity, healthy eating and low noise environments enhance sleep
4. ***Safe community.*** Neighbourhoods that are well maintained, well lit, and in which homes are designed to have "eyes on the street" are safer
5. ***Supportive relationships.*** Neighbourhoods that are designed to be able to see and interact with neighbours, whether directly outside the home or at nearby shops, enhance social cohesion
6. ***Clean, maintained home.*** A well-maintained home increases physical and mental wellbeing
7. ***Having an education.*** Good transportation systems, including public and active transportation, enable access to educational facilities
8. ***Having a steady job.*** Good transportation systems, including public and active transportation, enable access to jobs without undue cost

Transportation systems feature in the last two protective factors. Not only are they important to enable access to education and jobs, but once a person is using them, the commute time can increase stress levels.

In addition to these eight factors, we also know that exposure to forests and bodies of water have a positive effect on mental

Practical built environment ways we can improve mental health:

Buildings / Housing

- Design in opportunities for social interaction – through attractive common areas, walking paths, urban agriculture, and nearby shops
- Design with views of the street and of neighbours' homes
- Design with colour and light on the inside
- Provide views of water bodies
- Do not allow construction in flood- and forest-fire prone areas, and / or initiate stringent regulations to ensure that buildings and associated infrastructure are designed to continue functioning safely through disasters (e.g., appropriate ventilation systems, power and water backup)

Transportation

- Provide attractive, convenient, and safe public transit and active transportation facilities to encourage physical activity and reduce stressful commute times

Public Realm

- Provide parks and other facilities for activity close to home and work to encourage physical activity and physical connection to nature
- Create a network of public realm features that please, inspire, and enhance people's enjoyment

Water bodies

- Provide leisure access to rivers and oceans

Stormwater systems

- Design for future anticipated rainfall intensity

Utilities

- Design in resilience, whether centrally or by regulating backups for buildings.

wellbeing; Spending time in a forest increases natural killer cells by up to 50%. Natural killer cells are a lymphocyte that kill tumor and virus-infected cells, and are also associated with reduced depression. Being near or seeing a body of water can also calm us [28].

There's another aspect to our mental wellbeing. Beyond basic good health, buildings and spaces can be designed to enhance our productivity and creativity. Natural light, bright colours, open spaces and good air flow all contribute to these improvements.

Major disasters can damage our built environment, removing much of the foundation that we depend on to remain healthy. 35% of Canadians report having been involved in a major emergency or disaster in their lifetime. The most common types of emergency are winter-related storms (46%), extended power outages (36%) and floods (12%) [29]. 32% of affected Canadians report financial impact; 8% report having experienced emotional or psychological effects, and 3% report injury or illness as a result of the emergency. While our built environment cannot protect against all of these, greater resilience within our power networks and stormwater systems, including backup power and other utilities, keeping buildings out of floodplains, and more resiliently designing buildings, could reduce the amount of physical, financial and emotional damage sustained by Canadians.

THE ECONOMIC BURDEN

The economic burden of poor physical and mental health is significant. Although there are many inter-linkages between physical and mental health, and many causal factors for each type of injury and illness, the table below gives an indication of the magnitude of economic burden the built environment could help relieve.

Illness or injury	Economic burden	Costs Include	% influenced by built environment, through enticement of physical activity and healthy food choice and overall design
Mental illness	$49 billion (2011) [6]	Direct (43 billion) + Indirect	Unknown [30]
Heart disease	$18.5 billion (1998) [31]	Direct (7 billion) + Indirect	20-27
Diabetes	$13 billion (2013) [32]	Direct (3.4 billion) [5] + Indirect	15+
Falls (for seniors)	$8.7 billion (2010) [33]	Direct (2 billion) + Indirect	Unknown
Cancer	$7.5 billion (2012) [34]	Direct only	27
Transport incidents	$4.3 billion (2010) [34]	Direct (2 billion) + Indirect	Unknown

SUMMARY (OF EVIDENCE SECTION)

If we continue to design our built environment in the same way, it will continue to contribute to increases in incidences of obesity, diabetes, cancer, respiratory illness, falls, heart disease, and mental illness. This is why we, as designers of the built environment, need to mobilize.

As planners and designers of the built environment, the legacy of our plans and designs last 30 to 100 years or more. If we could plan, design and build our communities and facilities to motivate and compel people to be more physically active and make healthier food choices, then we could begin to reverse these alarming trends.

	2017	2030	
	Current	*Predicted*	*What could be if we designed differently*
Cancer: *new cases diagnosed per year*	*206,000*	*289,000*	*216,000*
Diabetes: *total cases*	*3.2M*	*4.7M*	*3.7M*
Mental illness: *cost per year*	*49B*	*156B*	*TBD*
Obesity: *# Canadians (not a disease, but a precursor to diseases)*	*10M*	*14M*	*12M*
Falls: *# falls-related injuries per year*	*82,000*	*162,000*	*TBD*

Planning for vulnerable populations

Who is more vulnerable and why?

Trends in vulnerable populations

Designing and planning for vulnerable populations

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VULNERABLE POPULATIONS: WHAT MAKES THEM MORE VULNERABLE? WHY IS THIS IMPORTANT? AND HOW CAN WE DESIGN FOR THEM?

We were struck – and inspired – by the fact that all experts interviewed stressed the importance of planning and designing for our most vulnerable Canadians. They identified vulnerable populations as people who were more at risk of physical or mental health problems and who tended to be older, have lower incomes, be less able-bodied and -minded, were First Nations or other minorities, who lived in remote and rural areas, and who were newcomers to Canada. Overall, our proportion of the population that is vulnerable is increasing, and if we are to reverse negative health trends, then these are the people we must focus on.

EVIDENCE: WHY ARE LOWER-INCOME, OLDER, LESS ABLE-BODIED AND -MINDED, FIRST NATIONS AND MINORITIES, RURAL AND REMOTE RESIDENTS, AND IMMIGRANT INDIVIDUALS MORE AT RISK?

This is best summed up by one of our interviewees:

> *What we know is that where you live is the strongest predictor of health. People in lower income neighbourhoods are in worse health. This is because their environments have less access to good facilities and good transport, little to no green space, and less nutritious food. But designing our neighbourhoods differently can almost completely override income differences.*

Less able-bodied and -minded, and immigrant people also have less access to healthy facilities, due to physical, language, or cultural limitations.

People living in remote and rural communities tend to have fewer healthy facilities, because their communities do not have the population base to be able to afford them. As a result, they are geographically further from healthy facilities. And when disaster strikes, they may be cut off completely from health services.

First Nations people and other minorities have services withheld from them because of prejudices against them, and assumptions that they are not credible in their reporting of needs and health issues, or that they are less deserving because they have created their own problems by drinking or taking drugs. An issue that is explained well in this article.

Newcomers are also more at risk of loneliness and social isolation because moving to a new place with a new culture and language is a stressful experience that is associated with higher rates of loneliness and social isolation [35].

TRENDS IN VULNERABLE POPULATIONS

Our vulnerable population is set to increase in number and proportion. Here's what we expect to see by 2031:

Older adults. The number of adults over 65 will have increased by 50% [36]. Older adults are at greater risk of suicide due to depression [37]. They are also three times as likely to report having a physical disability [38].

Less able-bodied. The number of Canadians living with a physical disability that impairs their mobility, vision, or hearing will rise from 2.9 million to 3.6 million, nearly double the pace of the population as a whole [39].

Lower income. The proportion of the population that is considered low income will increase. Although there has been no clear increase in income inequality in Canada in the past 20 years [40], this gap is likely to grow substantially for at least two reasons: First, automation will replace many lower-income jobs [41]. Second, climate change will damage more properties and displace more families, putting these families at a significant economic disadvantage, either temporarily or permanently.

First Nations. The Aboriginal population will make up 11% more of the population than it does today. Aboriginal peoples are the fastest-growing segment of Canada's population; between 2006 and 2016, their population grew by 42%, compared to 8% for non-Aboriginal people [42].

Remote and rural populations. The number of Canadians living in rural areas is projected to increase by 3%, although this will reflect a decrease relative to the urban population. In 2011, 20% of Canadians lived in a rural area [43].

Newcomers. Nearly half of Canadians aged 15 and older could be foreign-born, or could have at least one foreign-born parent – up from 39% in 2006 [44].

HOW WE CAN PLAN AND DESIGN OUR BUILT ENVIRONMENT TO PROTECT OUR MOST VULNERABLE POPULATIONS?

Extra focus on planning and design for the most vulnerable

Several interviewees believed that commitments to mixed-use, or live-work-play communities, should be enhanced for more lower-income neighbourhoods in particular, as they are typically the neighbourhoods that lack these design facilities and whose health suffers the most.

In the event of a disaster, due to a combination of dwindling budgets, increasing floods and forest fires, and increasing proportions of the population being vulnerable, municipalities may become less able to look after all citizens during a disaster. They would need to focus their efforts on the most vulnerable. So there would be work to do to prepare the less vulnerable members of a community to plan and manage for themselves, in the event of a disaster.

PRACTICAL SOLUTIONS:

Identify the most vulnerable populations for each municipality. Develop and maintain a socio-demographic portrait of our most vulnerable populations. Convene stakeholders in public health and specialists in vulnerable populations to identify the most vulnerable residents and develop indicators for their health, and plans in the event of a disaster. By creating profiles for each municipality, regions affected by extreme weather events can act efficiently and collaboratively

Commit to, and Create Live, Work, Play Communities. Municipalities commit to mixed use development in neighbourhoods where our most vulnerable people live. When residents live close enough to walk to work, school, shops, parks and other sports amenities, more social interactions and physical activity occur – and safer, more cohesive communities are created.

Mobile and flexible services for rural and remote residents

Rural and remote residents have limited access to health-supporting facilities, and developing full facilities in their neighbourhoods may not be financially or operationally viable. But advances in technology may help people in remote communities connect in with employment opportunities, bigger communities of interest, and medical professionals virtually. Advances in technology could also motivate people living remotely to be more physically active and healthy through gamification and diagnostics.

There are other solutions that don't require high-tech. The outreach model, for example, has been used in sports and public health for decades. It relies instead on mobilizing staff and equipment from one location to serve a more remote location – or to provide training to local staff, who can continue their training, practice and mentorship remotely.

PRACTICAL SOLUTIONS:

Use drones to carry medical equipment, supplies, blood and tissue samples and (eventually) personnel. This approach requires infrastructure like landing pads and charging stations in the remote areas.

Develop mobile infrastructure to be deployed to remote communities: In the event of natural disasters or outbreaks, mobile healthcare facilities could be deployed to remote areas, allowing for quick responses that are more cost effective than shipping individuals to larger urban centers.

Use digital devices and videoconferencing to track patients' health and have personal appointments. Surgeries have been performed remotely, so medical professionals should get more comfortable with remote conversations with their patients – and the health system should accommodate – or perhaps prioritize – this kind of care. Local requirements may include ensuring internet connection in people's homes, as well as small, centralized facilities that community members can visit for internet access and other care that can be delivered at the community level.

Designing for all Canadians

As professionals, we bring our own experiences into our designs – but this experience rarely reflects that of other users – particularly those who are disadvantaged in a way that we are not. So there are at least two angles of weakness to any professional's designs:

1. Our familiarity with the facility or system makes us oblivious to the specific needs of first-time or sporadic users; and
2. Our personal abilities, characteristics and experiences make us oblivious to the needs of users of different ages, physical and intellectual ability levels, digital literacy levels, mental health status, genders, income levels, and ethnicities.

In theory, a team of designers and reviewers should help to combat these biases. But in reality, Canada's design, planning and decision-making professionals are a relatively non-diverse group; largely weighted towards ages 30-60, able-bodied and -minded, middle- to high-income, 'established Canadians', and male. It is easy to see how we could well be designing, planning, and making decisions for ourselves, rather than for users, whether first-time or frequent. It will become more important to design with, rather than for, users as we have greater diversity of language, culture, physical ability, digital literacy, mental health, and age.

There's also an economic imperative to designing for a broader range of users. Less able-bodied people suffer from lower employment rates, a greater time burden in moving around their daily lives, and lower access to many facilities – which in turn increases feelings of social isolation and depression. Improving workplace accessibility alone would increase Canada's GDP by $17 billion [39], and this benefit doesn't even account for reduced healthcare for mental and physical health. Similarly, the more quickly newcomers can integrate into our communities, the more quickly they can contribute meaningfully to a healthier, wealthier Canada.

PRACTICAL SOLUTIONS:

Bias awareness design courses. Our educational institutions can have a significant impact by raising awareness about the need to design for diverse and first-time users, and to learn how to understand and incorporate their requirements. We envisage an entire course in engineering, architectural, and planning departments called "Designing out biases".

Introduce techniques for designing out biases. For professionals who are already willing to seek out and eliminate these biases, there are many techniques available for learning from users. To learn from younger users, for example, some designers have used child-centred audits by asking children to take photos of what they like and don't like about a place, how safe they feel, and how much the place draws them to want to play. [45]

Legislate universal accessibility. As much as designers and developers may wish to introduce greater accessibility into their designs, remaining cost competitive is crucial to maintaining a sustainable business. Only when all designers and developers are held to the universal accessibility standards, will accessibility become ubiquitous.

Not enough of this will happen without government intervention. A common theme across all of our interviewees was that individual professionals changing the way they practice will not do enough to change practice; government at all levels needs to introduce standards, regulation and policies that will commit professionals to designing facilities for everyone.

Climate change and volatility

How does climate affect our health?

Trends in climate that will affect our health

Designing and planning for climate to protect our health

wsp

CLIMATE CHANGE: THE IMPACT OF A CHANGING CLIMATE ON OUR HEALTH

EVIDENCE: HOW CLIMATE AFFECTS OUR HEALTH

Climate influences our physical activity levels, injury rates, mental health, and our livelihoods. Extremely hot, cold, windy, rainy, or icy weather keeps us indoors and less likely to be physically active [46] - which in turn can affect our risk of developing diabetes, cancer, heart disease, and mental illness.

Climate also affects both injury rates and mental health in at least three major ways. First, natural disasters such as flooding, forest fires and drought damage property and crops, cause injury, and disrupt lives, causing mental anguish as well as disadvantage economically. Second, and more directly, hotter weather is associated with greater violence and self-harm; a 1°C increase in temperature is associated with a 1% increase in suicide rate [47]. Third, as temperatures change, different organisms will be capable of living in new locations – infecting vegetation and people that were not previously exposed to them. Pathogens that have previously been frozen, and that we have not built up immunity against, for example, may be released by melting permafrost [48].

TRENDS IN CLIMATE

Our climate is predicted to bring us greater variability and volatility of temperatures and precipitation, which will increase our risks of flooding and forest fires.

Extreme weather. By 2050, we are expecting intense winter storms to become 8-15% more frequent than over the past 50 years (ref), and heatwaves will double [49]. That means that Canadians will exercise less as outdoor conditions become inhospitable more often.

Flooding. 20% of Canadian households are already at high risk of flooding and this number is likely to grow with increasing rainfall activity – with rare rainfall events expected to occur twice as often. Flooding is expected to cost the Canadian government $650M per year over the next five years [50].

Forest fires. By 2100, the amount of land burned by forest fires could double (ref).

HOW WE CAN PLAN AND DESIGN OUR BUILT ENVIRONMENT TO MITIGATE THE EFFECTS OF CLIMATE CHANGE TO OUR HEALTH

Our interviewees offered solutions to plan and design our built environment for climate change ranging from designing buildings differently, to valuing our green spaces. They were concerned that we choose low-carbon materials, use less energy, and change our lifestyles to dramatically reduce our carbon footprint.

They raised the likelihood that hospitals will become, even more than in the past, post-disaster epicentres, and must be designed to operate in such situations. This means they will need to be able to continue to operate when other infrastructure and utilities fail, and also that the people who manage and operate the facilities know how to shift from day-to-day operations to emergency response operations.

Building design (and location)

The design of a building dictates its resilience against extreme temperatures and wind, snow and ice loads and the amount of energy it will consume, and the choice of materials dictates the amount of embodied carbon the building will contain and emit. And perhaps most fundamentally, even though a lack of insurance may discourage may people from living in flood-prone areas, people who have little choice or are less aware of the risks, may still choose to live in flood-prone areas as long as it is permitted.

PRACTICAL SOLUTIONS:

Identify new extreme loads and temperatures. Identify maximum wind, snow, ice and hydraulic (flooding) loads and low- and high-temperature days, and frequency of these events, expected during the life of the building. These changes will fundamentally change the way we prepare for such events, especially when we consider that people spend 90% of their time indoors, and that buildings such as hospitals and care facilities house the most unwell and most vulnerable individuals in our society.

Identify second-order effect risks. Different climate conditions may mean that forest fires and airborne diseases become more commonplace. Special requirements could be specified for ventilation systems and containment of airborne pathogens.

Design to reduce reliance on air conditioning. Design buildings for reduced reliance on air conditioning. The mechanical and electrical components should then be designed for comfort during the identified extremes.

Choose climate-mitigating materials. Specify building and architectural materials that have low embodied carbon and low emissions. Locally sourcing components, where possible, will reduce carbon emissions from shipping methods.

Do not allow construction or living in flood plains where homeowners and residents will not be insured. Banning development from flood-prone areas would help protect residents – particularly lower income ones – from natural disaster. Subsidies or other arrangements could help lower-income residents who already live in such locations to relocate.

The importance of rehearsal

Even when buildings are designed for post-disaster situations, the entire function of the building changes during the disaster. And the people who have been running the facility during 'normal' operating situations will not be familiar with how to operate it during disasters. For example, which rooms were intended to take people who have been evacuated from their homes? How should those people be admitted and processed?

As climate change leads more Canadians to post-disaster facilities, it will become more important to ensure that the policies, procedures, training and rehearsal are in place. The human element becomes especially critical when a situation shifts from one operating mode to another.

PRACTICAL SOLUTION:

Rehearse post-disaster operating procedures. Ensure post-disaster policies and operating procedures are in place, and that staff rehearse them regularly.

Insurance industry practices could result in loss of greenspace health and environmental value

As our climate includes more dry days, hot days, and wet days, we will see more flooding, drought and forest fires, which will damage our greenspaces – a valuable asset that encourages physical and social activity, promotes mental health, and improves our air quality and environmental value. For insurance purposes, however, none of this health or environmental value is specified. That means that in the event of greenspace losses, the insurance industry is only required to replace the lost greenspace with greenspace of similar dimensions. For example, if a wetland is lost through a disaster, insurance industry practices may replace or substitute the lost wetland with a simple patch of grass. But this patch of grass does not provide the same biodiversity, carbon sequestration, storm water management benefits that the wetland did. As a result, as natural spaces and their diversity become compromised through natural disasters and climate change impacts, we are currently at risk of losing their positive benefits and intrinsic value permanently, unless efforts are made to replicate its previous form and function. Current practices mean that as our climate changes, we could lose a significant portion of the health and environmental value of our greenspaces.

PRACTICAL SOLUTION:

Regulate the monetization of greenspaces. Regulating the requirement for greenspaces to have a dollar or other tangible value assigned to them, and to be insured based on that value, will decrease the risk that municipalities will lose the valuable health and environmental benefits of greenspaces.

Lifestyle choices

The Intergovernmental Panel on Climate Change released a report in October 2018 with findings that our planet is set to warm by more than the 1.5 C scientists have been warning about [51]. The way we move around, what we eat, and the products and services we consume, all have a significant bearing on our changing climate. If we don't do something soon, any talk of health is moot.

PRACTICAL SOLUTIONS:

Introduce urban agriculture to neighbourhoods, schools and developments to encourage people to eat more fruits and vegetables over meat, cheese, butter, and foods sourced from elsewhere.

Offer facilities for active or public transport or electric vehicles

Design buildings with good insulation and low carbon materials.

Technology

How does technology affect our health?

Trends in technology that will affect our health

Designing and planning for technology to support our health

TECHNOLOGY: THE IMPACT OF CHANGES IN TECHNOLOGY ON OUR HEALTH

EVIDENCE: HOW TECHNOLOGY AFFECTS OUR HEALTH

Advances in engineering and medicine have had major positive impacts on our health, bringing us clean drinking water, more connected communities, and replacement limbs. But there is also significant evidence that technology can disrupt our sleep [52] and promote addiction to devices, games and social media in a way that leads to loneliness, depression, and in some cases, suicide [53].

On the other hand, these same technologies can motivate us to move and eat healthier, through step- and calorie-counting apps. They can also warn us when disaster is about to strike and help us figure out what to do.

In the healthcare sector, professionals are expecting to see far greater ability for personalized medicine, and diagnostics and treatment from home. Technologies will move from hospitals to your home or body, and they'll notify you earlier, so you have a better chance at a longer, healthier life.

Perhaps the biggest threat of technology to our health is that technological advancements displace jobs. Typically they replace jobs that require lower skill levels – jobs often held by Canadians who are already vulnerable. This displacement results in less ability to care for oneself and one's family, and also damages mental health. It is for this reason that our interviewees were fearful – as well as hopeful – about the impact of technology on Canadians' health.

TRENDS IN TECHNOLOGY

What is most striking about trends in technology is that the prediction timeframe is either extremely short, typically 1-7 years, or that the prediction is associated with no timeframe at all. It should come as no surprise, then, that our interviewees rated technology as the least certain set of trends. Some of the trends in technology that will affect our health are:

Connected "things". By 2025, more than 75 billion things, ranging from cranes to coffee machines, will be connected to the internet [54]. The Internet of Things, coupled with analytical abilities, will enable faster learning cycles, better predictive models, and better diagnostics of what can improve our health.

Automation and AI. More and more tasks currently undertaken by humans are expected to be automated over the next two decades – anywhere from 14% to 47% of jobs have been predicted to be replaced [55]. This trend will put more lower-paid jobs in jeopardy [56], and in turn put our vulnerable Canadians even more at risk of poor physical and mental health.

Autonomous and electric vehicles are expected to be make up 12-45% of fleet by 2045 [57, 58]. Electrification will reduce emissions, which will improve air quality and respiratory health – as well as the health of our environment, the foundation for healthy lives.

HOW WE CAN PLAN AND DESIGN OUR BUILT ENVIRONMENT FOR HEALTHIER TECHNOLOGY USE

To leverage the benefits of technological advancements and mitigate the risks, there are several things we can do:

Using technology to motivate us into healthier lifestyle choices.
Even just having information about the existence and real-time information about the timing and performance of a service, like bus services, has been shown to improve the perceived safety and anxiety levels of users, and even increase ridership modestly – and this is based on studies that did not invest in familiarizing users with relevant apps or attempting to gamify [59]. The power of technology to gamify and motivate people into more healthy lifestyles is clear, and we should for opportunities to embed these motivational approaches into our plans and designs.

PRACTICAL SOLUTION:

Pair built environment solutions with informational and motivating technology. For instance, a park could record and display the current number of users, tell you if your friends are there, or give you points for returning. At a more basic level, connecting people with information about the availability or real-time timing of a service may also make them more likely to make healthier choices, such as taking transit rather than their car.

The importance of familiarizing people with new technology.
While the benefits of new technologies can be immense, with the potential to significantly improve efficiencies and reduce costs, if people are not ready to use them, the new technologies can in fact double costs and frustrate service providers as well as users. One interviewee gave the example of one hospital introducing a new, automated food ordering system. The system would cut the need for people to take patients' ordering, saving tens of thousands of dollars per year. The hospital administration expected a 60% uptake, but only 30% of patients elected to use the app – so rather than being able to move primarily to the new system, the hospital ended up having to run both the automated and the people-based system – effectively doubling, rather than halving, costs. In some hospitals, waiting rooms contain miniature versions of MRI and other equipment so that patients familiarize themselves with something with which they have little experience.

PRACTICAL SOLUTION:

Usability design for new technologies. Usability design provides feedback on how technologies are viewed from fresh eyes, and helps the designer understand if they are likely to achieve their aims.

Training users. Users may need to be inducted, or trained in the use of the new technology. This training could be through an advance information packet, or a brief personal introduction by a staff member.

When is new technology not the answer?
New technology is not always the answer. Sometimes we have all the answers we need to solve problems that contribute to our health. For example, one of the greatest frustrations for people with a physical disability is the amount of time it takes to navigate neighbourhoods and buildings – because snow is not well removed, curbs aren't dropped to allow wheelchairs to roll down or up, and because there's no way of knowing which route will be completely navigable by wheelchair, or won't use more much energy than the user has available.

Another important technology consideration is for disaster situations, when mobile- electricity- and other higher technology-enabled solutions are used. Alternatives should be considered for the core design, as well as for backup. An important consideration we will need to take into account in our designs is where no- to low-technology solutions outvalue high-technology ones.

PRACTICAL SOLUTION:

Signage. Provide signage indicating where people can find an accessible entrance to a building, an elevator within a building, or a road crossing.

Low-technology alternatives. Provide alternatives for critical functions when power, water, telecommunications, and other infrastructure are not available.

The need for incentives

What kinds of incentives are required?

Why should government get involved?

THE NEED FOR INCENTIVES AND REGULATION

To ensure our built environment is designed and planned for good health, new government regulations and policies are required at municipal, provincial, and federal levels.

Without new incentives, the status quo will remain, and health problems will worsen, despite having many of the solutions to hand. This trend would continue because, despite individuals' and organizations' best intentions, market forces will punish new, untested, higher-risk, and higher-cost design and planning approaches.

Most, if not all, of our interviewees pointed to government regulation or standards as the ultimate backstop to ensure that planners and designers are doing enough to improve Canadians' health. It makes sense that the government should play a role, considering the following costs to our economy (note that some of these costs are likely to overlap):

- The economic burden of physical inactivity in Canada is $25 billion [60]
- The cost of not fully protecting our mental health, and of reactively treating it, is $50 billion per year – an amount that will triple (to $156 billion per year) in the next 13 years [6]. If a better built environment reduced mental health costs by only 5%, we'd have saved $8 billion by 2030.
- The burden of cancer on our economy is at least $7.5 billion per year [34]. Since 27% of cancers are influenced by the built environment, by promoting physical activity and healthier eating, a better built environment could save up to $2 billion in cancer burden.
- Diabetes costs the Canadian healthcare system and economy nearly $16 billion per year [32]. Since over 50% of type 2 diabetes could be prevented or delayed with healthier eating and increased physical activity [32], a better built environment could save up to $8 billion in diabetes economic burden per year.
- Designing workplaces for universal accessibility could increase GDP by $17 billion per year.

It is also clear that there is a role for government to incentivize collaborations between government departments and other organizations who have a health mandate or who have a significant influence on health – whether through academic / healthcare / private collaborations to accelerate medical advancements, or by introducing measures to evaluate both the capital and operational costs in a holistic manner that incorporates the health and wider economic benefits – where multiple parties may fund an initiative for which they all benefit, giving them all more resource. In so doing, we are likely to move to more preventive health in Canada, and happier, healthier citizens – and reduced burden on taxpayers.

Summary

What you can do to enhance Canadians' health in the built environment

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SUMMARY

In our quest for a more Future Ready built environment that will promote excellent health for all Canadians, we have identified the challenges that an increasingly volatile climate and new technologies will bring; they may exacerbate already rising levels of diabetes, cancer and mental illness. These trends may put our most vulnerable people at even greater risk of poor health. But we have also identified solutions that can mitigate, and even reverse, these trends, and the effects they may have on our health. Our solutions are summarized in the table below:

Trends	Problems	Design solutions
Changing climate	People will be evacuated from homes	Design buildings to withstand higher loads and pressures Prevent building and living in flood and other disaster-prone zones Regulate post-disaster facilities to have backup operating utilities Rehearse post-disaster operations of facilities
	Diseases will move to new areas	Design decontamination facilities into buildings
	Quality of air, water and land worsening	Choose low carbon building materials Design neighbourhoods to be walkable and have active or public transport nearby Introduce urban agriculture to neighbourhoods to reduce carbon emissions
	Greenspace will deteriorate	Government require greenspaces to be monetized for insurance purposes. Greenspaces and other public realm features to be valued based on health and ecosystem services.
	People less likely to exercise	Provide more indoor exercise facilities and more protective canopies near homes
New technologies	Automation will replace jobs, putting lower income families at greater disadvantage	Target lower-income neighbourhoods to be converted to live / work / play neighbourhoods to better support low-cost health
	Inadequate uptake for effectiveness	Familiarize users with new technologies in advance; 'normalize' the new and unusual
	May not function during disasters	Evaluate no- and low-tech solutions as alternatives or backups and their implications for health
	May be less effective than low-technology solutions	Evaluate the holistic costs of both options, from a user, health and cost perspective
Greater proportion and number of vulnerable Canadians	Less access to health-promoting facilities	Identify the most vulnerable residents Commit to mixed-used neighbourhoods for the most vulnerable populations Focus post-disaster planning efforts on the most vulnerable; prepare the more able residents for self-management Provide flexible and mobile services for rural and remote residents Teach designers how to design with, not for, all Canadians Legislate universal design Use Community Improvement Plans as an incentive for inclusive design Provide a comprehensive network of public realm features that inspire and enhance people's experience through their day.

A NOTE ON THIS RESEARCH

As part of our Future Ready program, WSP Canada is investigating trends in Technology, Society, Climate and Resources. Our aim is to understand how these trends may affect our communities and our clients' work, so that we can better design and advise on how to prepare for the future. This white paper focused on Society: Health, as well as the trends that converge to influence health.

This research was based on interviews with 13 experts in health and the built environment across Canada. Our interviewees represented a broad spectrum of thinkers in the Canadian health context, coming from the insurance, public health, medicine, facilities management, hospital management, health infrastructure procurement, climate change, municipal affairs, research, accessibility advocacy, and emergency response industries.

Our interviewees told us what they thought were the top trends that will affect Canadians' health in the next 20-30 years, and how we can design and plan our built environment differently to reverse, accelerate, or prepare for these trends. Despite the diverse backgrounds of our interviewees, they were surprisingly united in five assertions:

1. The built environment significantly influences health
2. The most important trend influencing health is climate change
3. The most uncertain trend influencing health is technological change
4. We must focus our health & built environment efforts on the most vulnerable Canadians
5. Without government intervention, there will not be enough consideration of health in planning and design of the built environment to make a meaningful contribution to Canadians' health

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We know that the future world will be vastly different from today, but thinking outside the current paradigm can be challenging to navigate. Through Future Ready, WSP brings clarity and vision to complex challenges and opportunities that are forecasted for Canada and around the world.

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