VICTORIA Transport Policy INSTITUTE
EFFICIENCY • EQUITY • CLARITY

www.vtpi.org
Info@vtpi.org
250-508-5150

Pandemic-Resilient Community Planning

Practical Ways to Help Communities Prepare for, Respond to, and Recover from Pandemics and Other Economic, Social and Environmental Shocks

17 June 2025

By Todd Litman
Victoria Transport Policy Institute

Resilient communities efficiently respond to economic, social and environmental shocks, including disasters such as pandemics.

Abstract

Resilience refers to a system's ability to respond to changes, including sudden shocks. This report investigates ways that communities can become more resilient to disaster risks including pandemics. It compares COVID-19 with other health risks, examines various problems caused by the pandemic, and recommends ways that communities can better prepare for, respond to, and recover from the pandemics. Pandemic-resilient planning requires policies that minimize contagion risks, provide basic access and delivery services during periods of restricted mobility, support physical and mental health during lockdowns, and provide affordable mobility for households with reduced incomes. To minimize contagion risk, communities ensure appropriate distancing, sanitizing and hygiene practices in public spaces including public transport vehicles and terminals. Walking and bicycling are generally the safest and most affordable modes, improve physical and mental health, and help reduce social isolation, so improving walking and bicycling conditions tends to increase resilience.

Table of Contents

Preface – Live Long and Prosper in an Unpredictable World

Imagine that in 2019 an oracle predicted that a disaster would soon restrict your travel, require your household to isolate for extended periods, and threaten your income. How would you prepare? You would probably collect medical supplies and stockpile food, enhance the comfort of your home with more natural light and ventilation, improve your telecommunications systems, and identify ways to reduce household expenditures if needed.

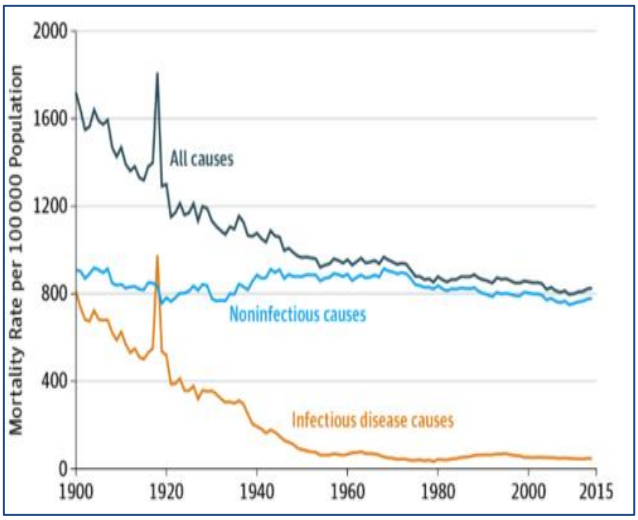
Similarly, imagine that you are a public official who received such predictions. How would you prepare your community? You would probably enhance your emergency management and healthcare programs, inventory emergency supplies, ensure that healthcare services can accommodate demand surges, implement transportation policies that can prioritize travel and provide access to essential goods and services, eliminate homelessness, and improve affordable housing and transportation options to serve residents with reduced incomes.

Major disasters are infrequent, unpredictable and highly variable. It would be a mistake to prepare for just one risk and ignore others. For these reasons, this report approaches this issue broadly; it considers how lessons from the COVID-19 pandemic can be generalized to help individual households and communities prepare for diverse health, environmental and economic shocks, including but not limited to pandemics. This can help people and communities live long and prosper despite life's uncertainties.

Executive Summary

This report explores how to prepare for the "slings and arrows of outrageous fortune," or to use modern terminology, how communities can increase their resilient to economic, social and environmental shocks, including pandemics and other disasters.

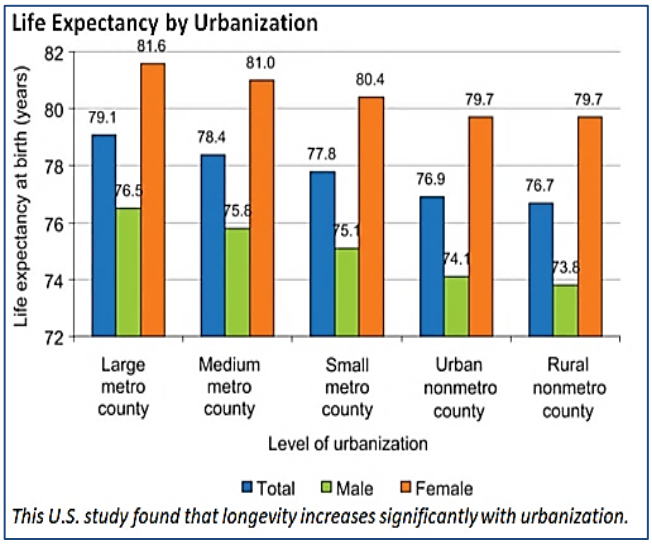
Infectious diseases are major risks. They can kill millions of people and impose huge economic costs. Fortunately, improved hygiene, vaccinations, healthcare, and other public health interventions have greatly reduced their mortality rates, as illustrated at right. Pandemics now kill fewer people, and cause far fewer potential years of lost life, than other health risks such as cardiovascular diseases, cancers, and accidents. However, the COVID-19 pandemic presented several problems, including the need to reduce contagion risks, particularly for disadvantaged groups, provide basic access and delivery services during quarantines and lockdowns, support physical and mental health during lockdowns, and provide affordable mobility for households with reduced incomes.



According to some people, the best disaster survival plan is to relocate to a secluded and well-stocked bunker, popularly called "prepping." However, for most households this is an ineffective and unrealistic solution. Although an affluent and healthy individual with practical skills and anti-social tendencies may be happy and healthy there, most people have responsibilities, including work, caregiving, and personal needs, that require access to public services and activities. Some people would soon die of boredom.

Analysis described in this report indicates that most people are best off during a disaster living in a walkable urban neighborhood with convenient access to common services and activities, and social connections that provide security and support. This is good news overall, because it indicates that policies to increase disaster resilience can also help achieve other community goals including affordability, economic opportunity and environmental protection.

Many factors affect contagion risks. People often assume that contagion increases with *density* (the number of people per unit of land), making cities particularly dangerous, but the risk is actually associated with *crowding* (the number of people within an enclosed space, such as a vehicle or house), and many rural residents have high contagion risk due to crowded homes and worksite (Hsu 2020). Most infection risks are associated with specific activities – long-distance travel, worksites, stores and social gatherings – that are similar in cities, suburbs and rural areas. Denser locations tend to have earlier outbreaks but not cases and deaths. Urban residents are less likely to die if infected due to better healthcare services, and urban living provides large health and safety benefits making cities safer and healthier overall, as illustrated to the right.



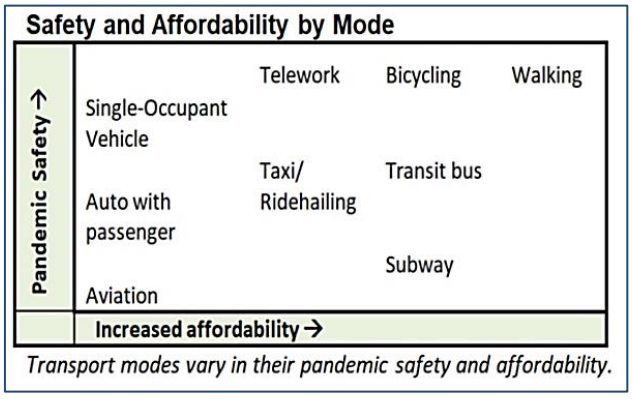
The table below summarizes special urban and rural pandemic risks and solutions.

Special Pandemic Risks and Solutions

	Urban	Rural Areas
Special Risks	• Crowded buildings and sidewalks • Elevators • Public transit • Homelessness and inadequate housing	• Vulnerable (old, poor, chronic illness, etc.) populations • Limited public health resources • Physical and social isolation • Poor access to medical facilities • Inadequate housing • Poverty and limited employment options
Solutions	• Targeted cleaning • Promote hygiene rules • Promote social distancing • Improve walking and bicycling • Eliminate homelessness and improve housing quality	• Improve public health services • Targeted outreach to isolated households • Improve access to essential services • High speed internet access and e-services • Financial assistance to poor and unemployed • Improve housing quality

Urban and rural areas have special pandemic risks that require special solutions.

To reduce the stresses of isolation, homes need adequate space, light and ventilation. Houses with ground-floor access have the least contagion exposure. Multi-family housing with shared entranceways, indoor hallways and elevators have additional risks, but these can be reduced with appropriate design, frequent cleaning and sanitizing, appropriate hygiene, and physical distancing.



Transport modes vary in their pandemic safety and affordability.

Travel modes vary in their risks and affordability, as illustrated left. All shared vehicles, including airplanes, trains, buses taxis, ridehailing, and private automobiles carrying passengers, can spread contagions. Walking and bicycling tend to have the least contagion risk, can serve people who for any reason cannot drive, provide exercise and are affordable, so improving walking and bicycling conditions tends to increase resilience. Improving walking and bicycling conditions tends to increase health and resilience.

Pandemics are just one of many risks that communities face, and generally not the most severe, so it would be inefficient to implement infectious disease reduction strategies that increase other health, economic, environmental problems, for example, by reducing physical activity which increases cardiovascular disease, or increasing vehicle travel and therefore traffic casualties and pollution emissions. To increase resilience, households and communities should be prepared with emergency management programs, develop robust and flexible infrastructure, and favor affordable and resource-efficient housing and transportation options. Many of these strategies provide many economic, social and environmental benefits, in addition to reducing disaster risks.

Analysis Scope

Planning analysis can vary in scope:

1. Infectious disease risks only.
2. All disaster risks.
3. All health impacts.
4. All economic, social and environmental planning goals.

More comprehensive analysis helps identify *win-win solutions* that achieve multiple goals, in addition to reducing infectious disease or disaster risks.

The table below provides checklists of ways that households and communities can increase their resilience to pandemics and other economic, social and environmental risks.

Resilience Planning Checklists

	For Households	For Communities
Reduces Pandemic Risks	• Resources to sanitize personal items, vehicles and homes, plus face masks and gloves. • A home with adequate space, home offices, natural light and ventilation, and private outdoor spaces such as a balcony, deck or yard to provide comfort for extended isolation. • Good communications resources, including telephone, internet service and computers for socializing, e-commerce and telework. • Fitness program, including in-home exercise and nearby walking and bicycling.	• Good public health programs, particularly infectious disease control and smoking reduction. • Healthcare services able to handle surges. • Shared vehicle density restrictions, cleaning and sanitizing, plus employee and passenger hygiene. • Minimal homelessness or inadequate housing. • Programs to address mental illness, substance abuse, domestic violence, and vulnerable resident supports. • Expanded pedestrian facilities to prevent crowding, traffic calming and road space reallocation.
Reduces All Risks	• Household emergency plan, including emergency contact information. • Emergency supplies, including first aid equipment, flashlights, mobile phone and portable radio backup power, and food for at least two weeks. • A home in a relatively safe location (out of floodplains and wildfire interface) built to withstand local risks such as earthquakes, hurricanes, plus extreme heat and cold. • Comfortable shoes for walking and a sturdy bicycle for riding. • Housing in a compact, walkable and bikeable neighborhood where essential services and activities are accessible without a car. • Ways to reduce household expenditures if income declines. • Positive relationships with neighbors.	• Emergency management with trustworthy leadership, reliable communications and critical supplies. • Robust internet and telecommunications networks, e-government, e-commerce, and delivery services. • Restrictions on development in high-risk areas such as floodplains and wildfire interface. • Zoning codes and house retrofit programs that ensure homes can withstand local risks such as earthquakes, and extreme weather, and are energy efficient. • Compact, walkable and bikeable neighborhoods where most essential services and activities can be accessed without using an automobile. • Sufficient affordable housing to serve demand. • Community cohesion, so most residents have positive relationships with their neighbors. • Unemployment insurance and support for lower-income households.

Good planning by households and communities can increase their resilience to pandemics and other risks.

Human intelligence allows us to learn from previous experiences and generalize those lessons to solve new problems. The COVID-19 pandemic is a good learning experience. The bad news: we face diverse and unpredictable risks: you can run, but you cannot hide. The good news: with smart planning we can greatly reduce those risks. This report should be of interest to policy makers, practitioners and the general public. Although focusing on North American conditions, many of the findings are applicable in other world regions.

Introduction

COVID-19 is a serious threat; it has killed many millions of people around the world (WHO 2022). Fortunately, public health interventions have reduced its spread and deaths. Thanks, health professionals!

However, we can do better. Unnecessary inadequate preparation reduced the effectiveness of public health responses, and communities face many practical problems in preventing infections and addressing the pandemic's social and economic impacts. During a disaster people often ask, "Why were we not better prepared?" Every disaster is unique, so it would be a mistake to prepare for identical future pandemics; we need to identify general principles that can help communities respond effectively to diverse risks. Planners use the term "resilience" to describe a system's ability to absorb shocks, that is, sudden economic, social or environmental changes. Many communities have goals to increase their resilience (100 Resilient Cities).

The pandemic created an interrelated set of problems that include illness and deaths, healthcare system stress, travel restrictions, isolation and lockdown requirements, fear and confusion, mental and physical stresses, plus lost income to individuals, businesses and governments. Although there is extensive literature on emergency management and community resilience planning, most existing publications focus on environmental threats such as hurricanes, earthquakes and wildfires; pandemics receive little consideration. Pandemics differ from most other disasters because they threaten people but not infrastructure, have long durations and huge economic impacts, as summarized below, so their mitigation is primarily concerned with protecting people and providing economic security, with little need for infrastructure protection and repair.

Exhibit 1 **Disaster Impacts**

Type	Scale	Duration	Warning	Healthcare Needs	Evacuation Needs	Economic Costs	Infrast. Damages
Earthquake	Large	Short	None	Large	Varies	Large	Large
Extreme weather[1]	Varies	Moderate	Short	Small	Moderate	Moderate	Moderate
Tsunami	Large	Short	Short	Moderate	Local	Large	Large
War/civil unrest	Varies	Short	Short	Moderate	Large	Moderate	Large
Wildfire	Large	Long	Moderate	Small	Moderate	Large	Large
Major utility failures[2]	Large	Moderate	Short	None	None	Large	Large
Chemical spill/fire	Small	Varies	Short	Large	Local	Large	Large
Pandemic	*Very Large*	*Very Long*	*Long*	*Very Large*	*None*	*Very Large*	*None*

Pandemics are one of many types of disasters that should be considered in emergency response planning.

1. Extreme weather includes hurricanes, tornados, blizzards, ice storms, and extreme cold and heat.

2. Major, long-term utility failures could result from technical failures, extreme weather, terrorist attacks or solar flares.

This report investigates these issues. It compares COVID-19 with other health risks; examines various impacts on people and economic activity; identifies specific problems such as homelessness and unaffordability; compares urban and rural risks; and recommends specific ways that communities can better prepare for, respond to, and recover from pandemics and other shocks. This report focuses on actions that can be implemented by individual households, community organizations, local and regional government. It highlights "win-win" strategies that increase resilience while helping to achieve other community and household goals. It should be of interest to anybody involved in emergency response or community resilience planning, or who wants guidance preparing their own household for future disasters.

Principles of Resilience

The future is unpredictable so smart planning prepares for possible unexpected changes, what economists call *shocks*, or as my grandmother recommended, we should "hope for the best but prepare for the worst." This would be easy if we faced just one possible shock, but there is a large range of possible threats that individuals and communities may face (Weilant, Strong and Miller 2019). Below are general principles for community resilience.

Prepared and Responsive

Prepared and responsive means that communities have trustworthy leadership, effective emergency management programs, and good communication that allows public officials to communicate with residents and residents to communicate with public officials.

Robust, Secure, Redundant and Flexible

Critical infrastructure must be strong, redundant and flexible in order to withstand potential stresses and failures, and should avoid higher-risk locations. For example, earthquakes cause much less damage and casualties in areas with strong building codes, and extreme weather is less likely to cause power failures where utility lines are underground. Similarly, for security sake, homes and communities should avoid vulnerable floodplains, shorelines and forests susceptible to wildfires, risks that are increasing with climate change.

Diversity

A diverse system is better able to respond to unexpected changes. For example, people who normally travel by automobile should value having alternatives, such as good walking, bicycling and public transport in their community, for possible future situations in which they cannot or should not drive, because of a vehicle failure, medical problem or lost income, or because a disaster makes roads impassable or fuel unavailable. Drivers also benefit from non-auto modes that reduce their chauffeuring burdens. Similarly, households benefit from having diverse home heating and cooking options, food supplies, and employment opportunities.

Affordable and Resource-efficient

If we are lucky, we will always be affluent, but we should prepare for the possibility that sometime we will be impoverished and need more affordable options. Since housing and transportation are most household's two largest expenses, affordable housing and transportation are particularly important for resilience planning.

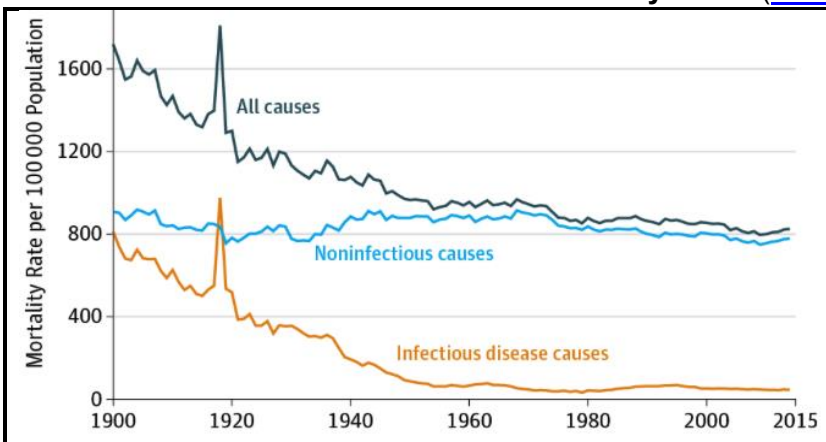
These principles can be applied to many types of planning decisions. For example, this suggests that to increase resilience, households should choose homes, and communities should design neighborhoods, that are in lower-risk locations, with efficient and redundant public infrastructure, and build multi-modal transportation systems that provide convenient access to important services and activities without requiring an automobile. These principles also suggest that communities should ensure that affordable housing and transportation options are available, so any household, including those with low incomes, physical impairments or other special needs can find suitable affordable homes in a walkable neighborhood.

These principles increase a community's resilience to many risks including pandemics and other disasters, and individual households' resilience to shocks such as lost income and physical disabilities. Although a pandemic does not damage physical infrastructure like natural disasters, it does stress household infrastructure and constrain travel activity, and its financial impacts will force many households to need more affordable housing and transport options.

Comparing COVID-19 with other Health Risks

Infectious disease epidemics, including smallpox, typhus, plague, cholera, polio, and measles, were once common and deadly (Healthline 2016). Fortunately, better hygiene, vaccines, and improved medical treatments greatly reduced these risks, as illustrated below. Globalization increases contagion dispersion but also prevention effectiveness, so even highly contagious and deadly diseases can be controlled. As a result, our infectious disease risks are far smaller than our grandparents'.

Exhibit 2 **U.S. Infectious Disease Mortality Rates** (Hansen, et al. 2016)

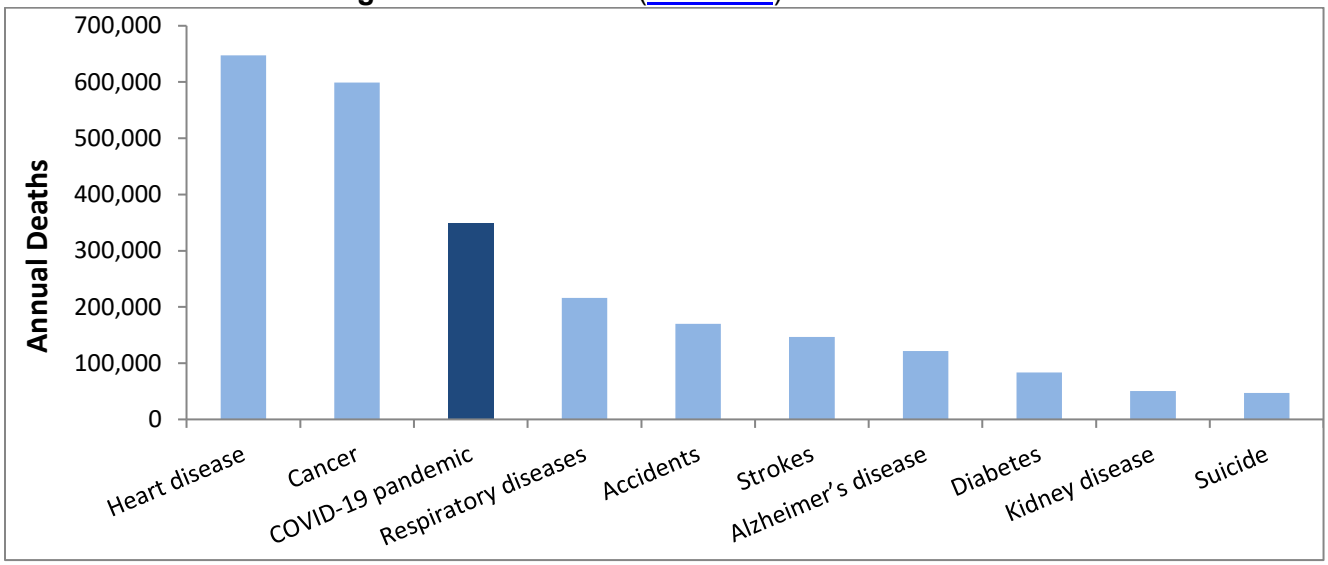


Improved hygiene, vaccinations and medical treatments reduced infectious disease death rates about 90% between 1900 and 1950, which significantly reduced total mortality rates.

Note the 1918 Spanish flu spike, and the small increase between 1980 and 1995 due to AIDs and recent tuberculosis outbreaks.

COVID-19 is dangerous due to its relatively high transmissibility and mortality rates (CEBM 2020; Varity, et al. 2020). Exhibit 3 compared it with other major causes of death. In killed than a million people in the U.S. (WHO 2022). Because COVID-19 tends to kill older people, it causes smaller reductions in Potential Years of Life Lost (PYLLs), a metric that accounts for the average age when people die.

Exhibit 3 **U.S. Leading Causes of Deaths** (CDC 2018)



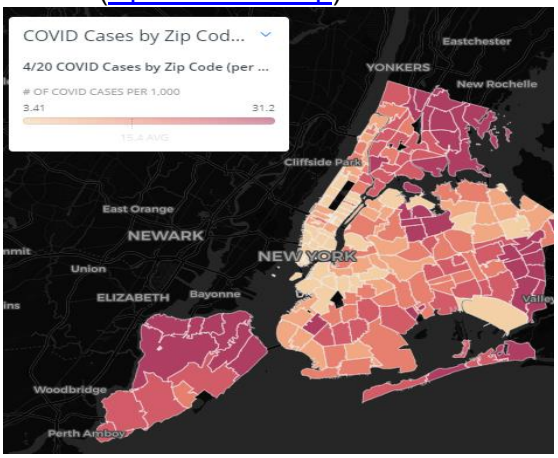
This figure compares 2020 COVID-19 deaths with other major causes of death, based on 2017 data. COVID ranked third and represented about 14% of total annual deaths.

Comparing Risks by Location

Health risks vary by location (Badger 2020; Frank and Wali 2021). Many people assume that contagion risk increases with density, making cities dangerous (Dawid 2020; Rosenthal 2020), but subsequent research indicates that this is generally untrue (Fox 2020; Hejazi, et al 2023; Smith 2020; Steuteville 2020; Zhang, et al. 2022). For this analysis it is important to distinguish between *density* (people per acre) and *crowding* (number of people in an enclosed space such as a vehicle or building). Contagion tends to increase with crowding, not density (Yang, et al. 2021). There is no reason to believe that worksites, stores, and healthcare facilities in cities are more contagious than in suburban and rural areas. Although infection exposure tends to increase with density, other factors, such as design, behavior and healthcare policies are more important, so well-designed and managed cities have lower infection and fatality rates than sprawled areas with poor programs (Li, Richmond and Roehner 2018).

High initial infection rates in large cities such as Chicago, New York and Seattle reflect their global connections as centers of travel, trade, tourism and migration, not their density (ITDP 2020). Using sophisticated statistical analysis Carozzi, Provenzano and Roth (2020) found that denser locations tend to have earlier outbreaks, but no evidence that population density increases total COVID-19 cases and deaths. COVID-19 eventually reached most rural areas, many of which had high infection rates (Healy, et al. 2020). Some dense cities such as Hong Kong, Singapore and San Francisco, and highly urbanized countries, such as Japan, South Korea and Taiwan had low COVID-19 deaths (Kahn 2020; Leonard 2020; Lindeke 2020; Normile 2020. Many suburban and rural areas had higher infection rates than nearby cities (Bliss and Capps 2020; Dobkin and Diaz 2020; Keil, Connolly and Ali 2020).

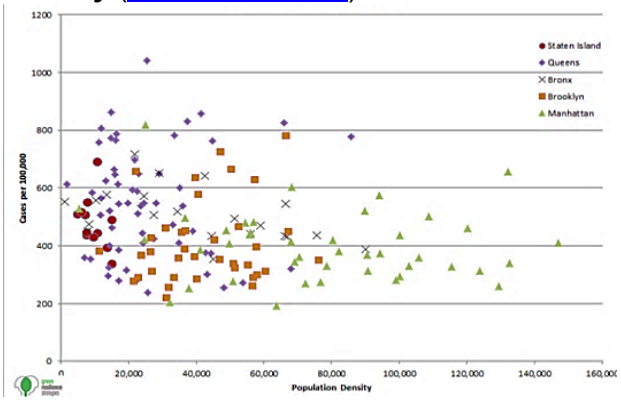
Exhibit 4 **New York City COVID-19 Cases** (Open Street Map)



Infection rates are much higher in lower-density outer suburbs than in central neighborhoods.

Wali and Frank (2021) found that in the Seattle, Washington region, COVID hospital and fatality rates increased with sedentary travel and declined with active travel (walking and bicycling), and were lower in more mixed and connected neighborhoods. Hamidi, Sabouri and Ewing (2020) found that, accounting for other risk factors, COVID-19 infection rates are not significantly related to density, and higher density counties had much lower virus-related mortality rates, probably due to better health care. The figure to the right shows the negative relationship between neighborhood density and COVID-19 infection rates in New York City. COVID-19 eventually reached most rural areas, many of which had high infection rates (Healy, et al. 2020). Rader, Scarpino, Nande, et al. (2020) found that, in China and Italy, larger and denser cities had larger and longer COVID-19 outbreaks, while smaller and less dense areas had shorter but more intense outbreaks. Han, Miao and Zhang (2023), found that in Chinese cities COVID infection rates increased with density, but so does healthcare quality, so density does not affect death rates. Similarly, Khavarian-Garmsir, Sharifi and Moradpour (2021) found that in Tehran, infection rates where negatively associated with income but unaffected by density.

Exhibit 5 **NYC COVID-19 Versus Density** (Winkelman 2020)

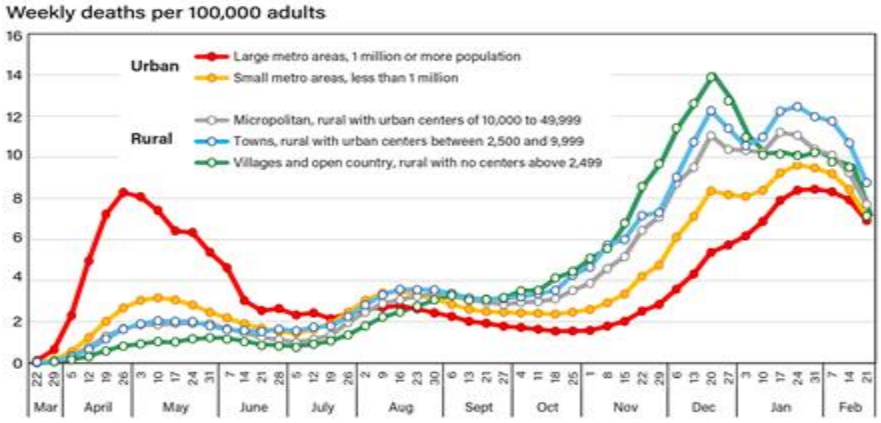


Denser New York neighborhoods had lower infection rates than in low-density suburbs.

Frank and Wali (2021) find that, because COVID infection rates are much higher for people with underlying health risks such as obesity and chronic diseases, compact walkable areas tend to have less COVID risk. They found that a one percent increase in obesity is correlated with a 9.4 unit increase in COVID-19 fatality per 100,000 population. After controlling for demographics and unobserved factors, they found that a one-unit increase in residential density is associated with an average 4.5 unit decrease in fatalities.

For this analysis, it is also important to measure risk *per capita*. Denser areas tend to have more total COVID cases, but less dense areas tend to have higher infection and death rates. Although the pandemic took longer to reach rural areas, once established it had higher fatality rates due to higher-risk populations, low vaccination rates, and weaker public health and healthcare services, as illustrated below.

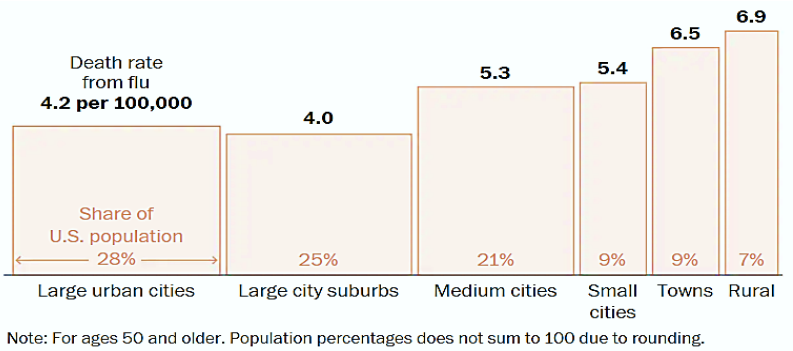
Exhibit 6 **Urban-Rural Covid Death Rates, March 2020 to Feb. 2021** (CDC Data)



COVID infection and death rates were initially much higher in large cities because they have more international travel and employment, but once infections reached rural areas their death rates increased and are much higher than in urban areas due to older and less healthier populations, lower vaccination rates, weaker public health programs and less access to healthcare.

Normal flu epidemics follow similar patterns (Dalziel, et al. 2018). Rural residents tend to be more vulnerable to infectious diseases due to their demographics (they are older, poorer, and have more chronic diseases and higher smoking rates), limited public health systems, and poor healthcare access (Keating and Karklis 2020). Flu death rates are much higher in rural areas than in large cities and suburbs, as illustrated below. As pandemic expert Professor Eva Kassens-Noor explains, "Rural populations have less means to contract it [coronavirus], but rural populations have less means to treat it." (Bliss and Capps 2020).

Exhibit 7 **Flu Fatality Rates by Location** (Washington Post, 19 March 2020)

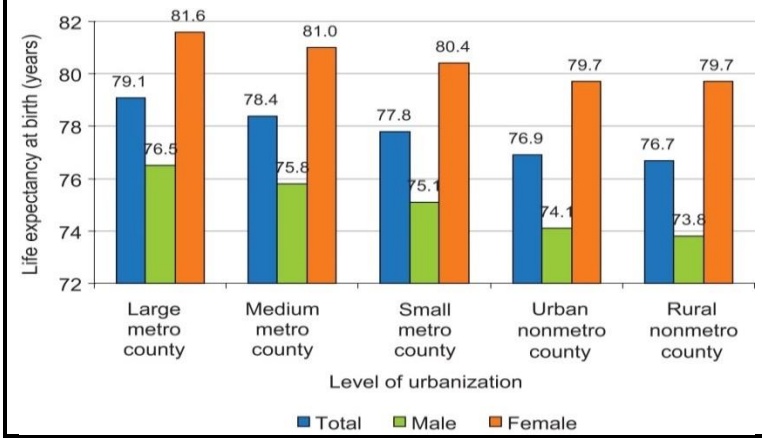


Flu death rates tend to be higher in rural areas than in large cities or suburbs.

If COVID-19 follows this pattern, any lower exposure rate in rural areas is likely to be offset by higher fatality rates.

Overall, city residents tend to have greater risks from infectious diseases, high-rise fires and street crime, but rural residents face greater risks from chronic diseases, accidents (particularly traffic crashes), suicides, and some disasters (such as wildfires), plus less healthcare access and slower emergency response. In addition to improved health and safety, urbanization tends to reduce most major causes of death (cardiovascular and respiratory diseases, cancers and unintentional injuries), and so increases overall longevity (Cosby, et al. 2019; Hamidi, et al. 2018; Sallis, et al. 2016), as illustrated in the following graphs.

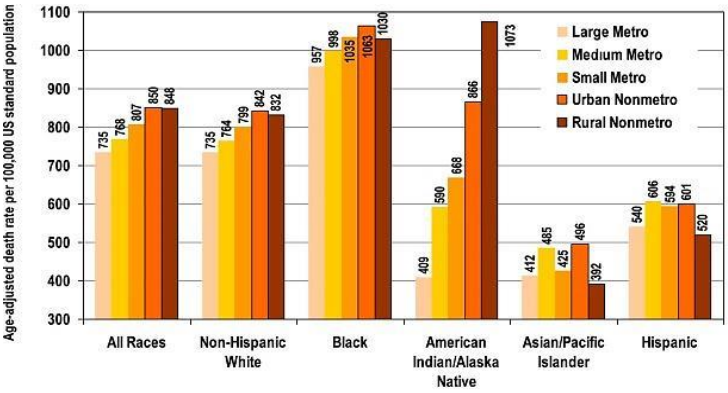
Exhibit 8 **Life Expectancy by Urbanization, U.S., 2005–2009** (Singh and Siahpush 2014)



This U.S. study found that longevity increases significantly with urbanization for all demographic groups. Large metro residents live 2.4 more years than rural residents, on average. Urban-rural differences are even greater for poor and minority groups.

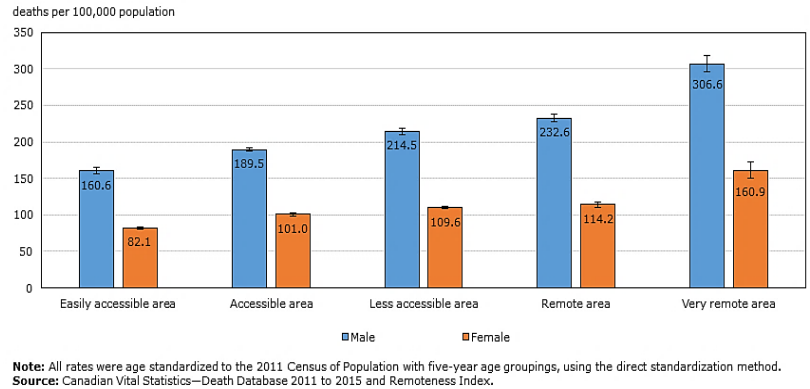
Rural residents have shorter lifespans due to higher rates of cardiovascular, respiratory and kidney diseases, unintentional injuries lung and colorectal cancer, suicide, diabetes, Alzheimer's disease and birth defects.

Exhibit 9 **Age-Adjusted Death Rates, U.S., 1990–2009** (Singh and Siahpush 2014b)



This U.S. study found that mortality rates are lowest in large metro regions and tend to increase with rurality for most demographic groups. Urban-rural disparities are particularly large for poor and most minority groups, and increased in recent decades. Rural residents have higher rates of cardiovascular and respiratory diseases, unintentional injuries, lung cancer, suicide, diabetes, pneumonia/influenza, cirrhosis, and Alzheimer's disease.

Exhibit 10 **Preventable Mortality in Canada** (Subedi, Greenberg and Roshanafshar 2019)



Note: All rates were age standardized to the 2011 Census of Population with five-year age groupings, using the direct standardization method.
Source: Canadian Vital Statistics—Death Database 2011 to 2015 and Remoteness Index.

This Canadian study found that preventable mortality is lowest in easily accessible (i.e., urban) areas and increases with remoteness (i.e. rural). These differences result from demographics (remote community residents tend to have lower incomes and less education), plus higher rates of cardiovascular disease, cancers, diabetes, accidents and suicides, plus less access to healthcare.

The table below summarizes various contagion risk factors and ways to reduce them.

Exhibit 11 Contagion Risk Factors and Solutions

Risk Factors	Risk Reduction Strategies
Long-distance travel	Limit mobility and require quarantines, particularly from higher-risk areas.
Crowded buildings	Limit crowding, clean touch surfaces, and encourage resident, employee and visitor hygiene.
Stores and restaurants	Limit crowding, use delivery services, clean touch surfaces, and encourage hygiene.
Shared vehicles	Limit crowding, clean touch surfaces, encourage hygiene, protect operators.
Sidewalks and paths	Reduce crowding and encourage distancing. Pedestrianize streets.
Social gatherings	Forbid or discourage social gatherings, clean touch surfaces, encourage hygiene.
Nursing homes and medical facilities	Develop comprehensive infection prevention, testing and control protocols, limit access by non-essential visitors, encourage hygiene, protect staff.
Homelessness	Provide housing for homeless residents and targeted services to vulnerable groups.

Infectious diseases present specific risks which can be reduced.

This analysis indicates that it would be misguided to move from a city to a rural area to reduce pandemic risks because other risks are greater overall. Rather than abandon cities, resilient community planning reduces risks in all geographic areas. The table below summarizes special risks and risk reduction strategies for urban and rural communities.

Exhibit 12 Special Pandemic Risks and Solutions

	Urban	Rural
Special Risks	• Crowded buildings and sidewalks • Elevators • Public transit • Homelessness and inadequate housing	• Vulnerable (old, poor, chronically ill, etc.) populations • Limited public health resources • Physical and social isolation • Poor access to medical facilities • Inadequate housing • Poverty and limited employment options
Solutions	• Targeted cleaning • Promote hygiene • Promote physical distancing • Improve walking and bicycling • Eliminate homelessness and improve housing quality	• Improve public health services • Targeted outreach to isolated households • Improve access to essential services • High speed internet access and e-services • Financial assistance to poor and unemployed • Improve housing quality

Urban and rural areas have special pandemic risks that require special solutions.

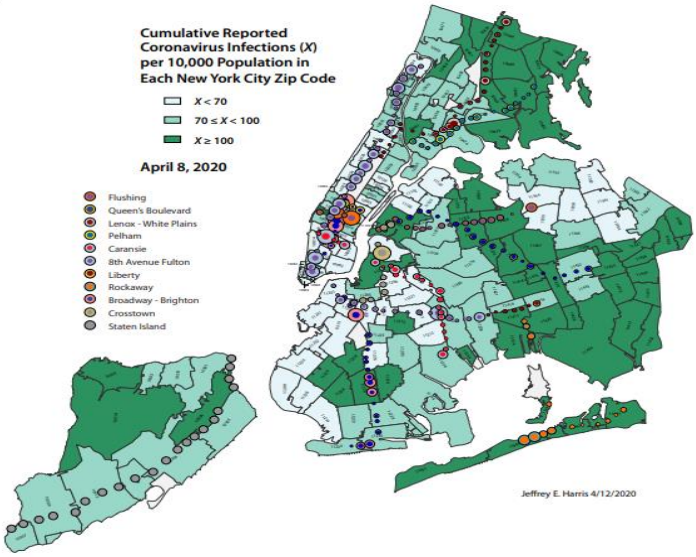
Transport Risks and Solutions

Both long-distance and local travel present contagion risks: long-distance travel can introduce diseases into a community and local travel can disperse it. Transport hubs and corridors, such as airports and highways, are often gateways to diseases. All shared vehicles present risks: buses, trains and airplanes have confined vehicles and stations. Automobiles used for taxis, ridehailing, or carrying family and friends tend to be even more confined and have numerous touch services (handles, arm rests and seats). These risks are difficult to compare; for example, it is uncertain whether total contagion risk is lower if 1,000 non-drivers travel on 100 buses with 10 average passengers, 500 taxi/ridehail vehicles with a driver and two average passengers, or 1,000 private cars with a driver and one passenger, since each presents unique risks.

This suggests that to reduce risks travellers should minimize all types of shared vehicle travel, including private automobiles, taxi and ridehailing, and public transport. This can severely constrain the out-of-home activities of non-drivers in automobile-dependent areas. Even urgent rides, such as healthcare access, can be difficult and costly in sprawled areas where taxi and ridehailing services are limited and travel distances are long. Intercity vehicle travel may also be inconvenient, due to limited traveler services.

Public transport can present special risks. A paper by Jeffrey E. Harris, *The Subways Seeded the Massive Coronavirus Epidemic in New York City*, claimed that subways were a major cause of COVID-19 dispersion in New York City, based on maps showing reported cases concentrated along subway lines, and because March 2020 ridership declines were followed by reductions in new cases, but critics point out that infection rates are actually higher in more automobile-oriented suburban areas than in transit-oriented areas, and many other contagion-control policies were implemented in late March which can explain the decline in new infections (Furth 2020; Gordon 2020; Grabar 2020; Levy 2020; Sam Swartz 2020; Winkelman 2020).

Exhibit 13 **New York City Infection Rates** (Harris 2020)



Harris claimed that this map demonstrates a positive correlation between subway ridership and COVID-19 infections, but critics point out that infection rates were much higher in the more automobile-oriented outer neighborhoods of Staten Island and the Bronx, and low in dense, transit-oriented neighborhoods in Manhattan and Brooklyn. For critical analysis see:

Automobiles Seeded the Massive Coronavirus Epidemic in New York City (*Furth 2020)*

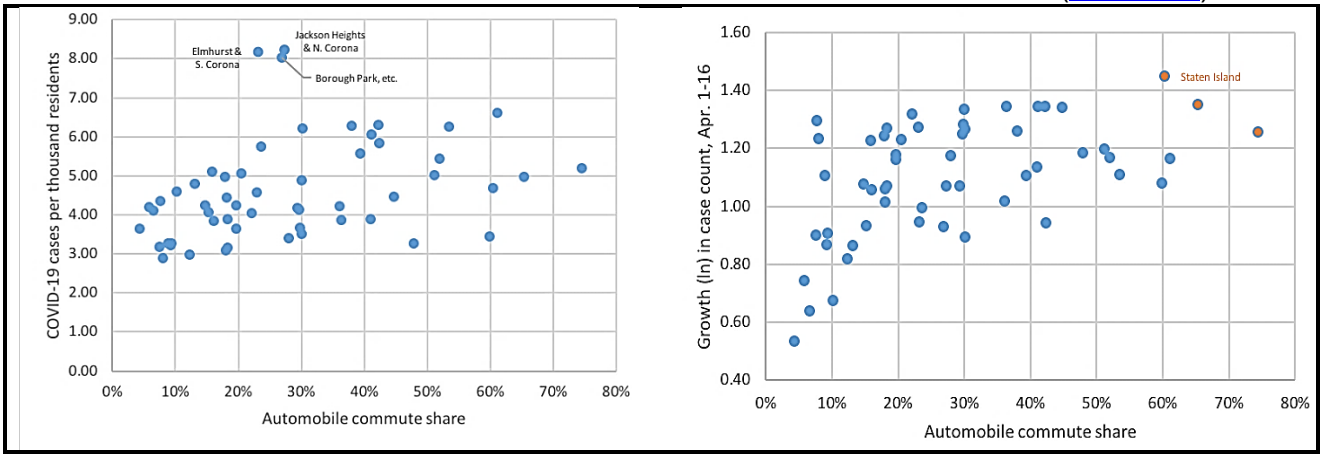
It's Easy, But Wrong, to Blame the Subway for the Coronavirus Pandemic *(Gordon 2020)*

The Subway is Probably not Why New York is a Disaster Zone (Levy 2020)

Analysis of New York COVID-19 infection patterns by Yang, et al. (2021) and Huang and Li (2022) found that infection rates increased with public transit station density and commute distance but not with commute mode shares, indicating that longer durations in buses and trains increases contagion. Analysis by Salim Furth, *Automobiles Seeded the Massive Coronavirus Epidemic in New York City*, shows that neighborhood COVID-19 infection rates tend to decline with transit mode share and increase with automobile mode

share, as illustrated below. He identifies various ways that motorists are likely to spread disease more than transit users: motorists tend to travel farther, visit more destinations, and reduce their vehicle trip-making less than transit users, and take fewer precautions because driving seems safer than transit travel.

Exhibit 14 **COVID-19 Infection Rates Versus Auto Commute Mode Share** (Furth 2020)



Salim Furth's study, Automobiles Seeded the Massive Coronavirus Epidemic in New York City, shows statistically strong positive correlations between automobile commute mode shares and both COVID-19 infection rates (left figure) and April 1-16 infection growth rates (right figure), plus strong negative correlations between both subway and other transit commute mode shares and infection rates.

Transit risks can be reduced by limiting crowding, appropriate cleaning and sanitizing, employee and passenger hygiene, operator protection (Fletcher, et al. 2014; Levy and Goldwyn 2020), and operational improvements that reduce delay (Transit Center 2020). Taxi, ridehailing and motorists carrying passengers can reduce risks by limiting crowding, cleaning, sanitizing and hygiene. Taxi and ridehailing companies can offer sick leave so drivers are less likely to work when they may be contagious. Delivery services reduce but do not eliminate risk since couriers handle many people's goods. Walking, bicycling and telework are generally the safest and most affordable travel modes, making walkable urban neighborhoods resilient, particularly if they are designed for minimal crowding and *sociable distancing* (Mehaffy 2020).

Exhibit 15 **Transportation Contagion Risks and Solutions**

Risks	Solutions
Long-distance travel	Limit mobility and require quarantines, particularly from higher-risk areas.
Private vehicle travel	Avoid carrying passengers, clean touch surfaces, encourage hygiene.
Taxi and ridehailing	Limit crowding, clean touch surfaces, encourage hygiene, protect operators.
Public transit vehicles	Limit crowding, clean touch surfaces, encourage hygiene, protect operators.
Terminals	Limit crowding, clean touch surfaces, encourage hygiene, protect employees.
Walking and bicycling	Encourage distancing. Limit automobile traffic and open streets to active modes.
Automobile dependency	Create neighborhoods with convenient walking and bicycling access.

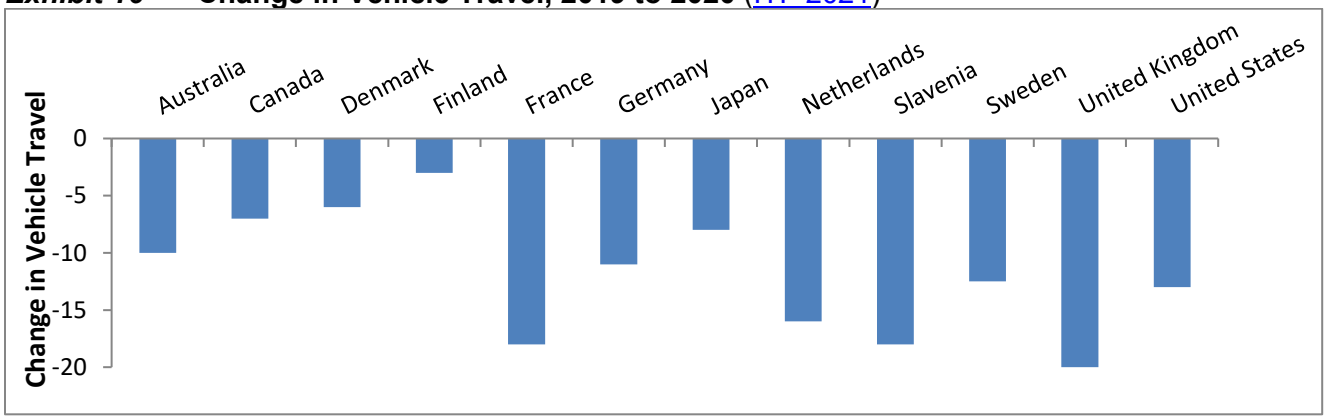
Travel activities impose various risks which can be reduced.

Changes in Travel Activity and Crashes

How did the pandemic affect travel activity and crash rates? Below are some key impacts:

- Travel and business activity restrictions, and stay-at-home orders, greatly reduced automobile and public transit travel (Heisler 2020), which reduced traffic congestion, accidents and air pollution (Lunden and Thurlow 2020; Sahagun 2020). The figure below shows vehicle travel reductions in twelve countries that publish travel data.

Exhibit 16 **Change in Vehicle Travel, 2019 to 2020** (ITF 2021)



The pandemic reduced total vehicle travel in all countries with available data.

- Longer urban trips declined significantly and shorter trips increased in many cities, as illustrated below.

Exhibit 17 **Changes by Trip Length in Six Cities, 2019 to 2021** (Rode 2021)

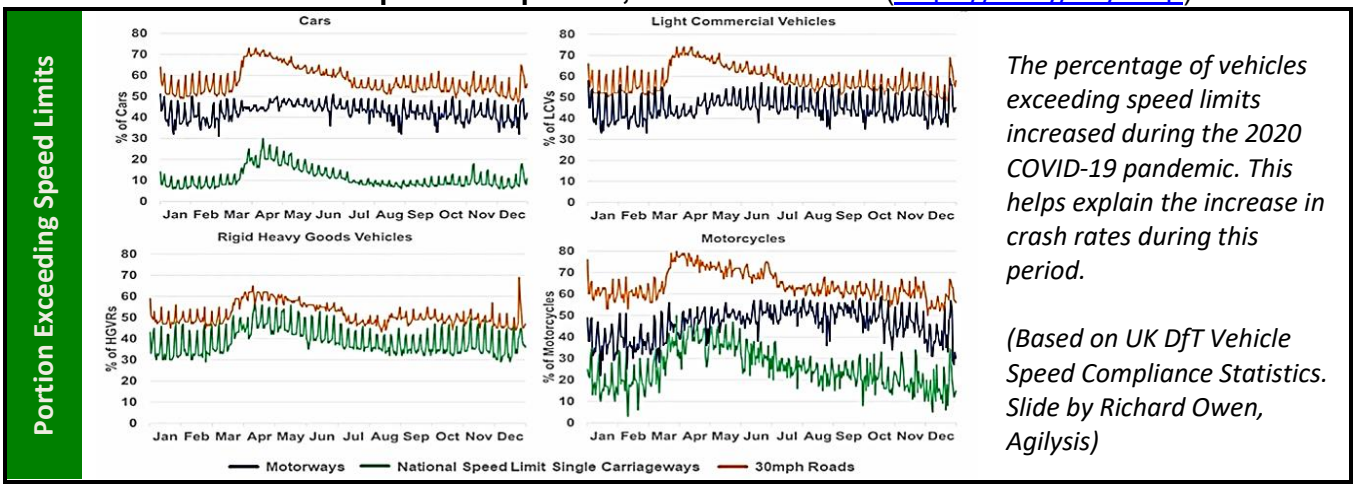
The pandemic, reduced medium (2-10 kms) and long (> 10 kms) trips, and increased short (< 2 km) trips in some cities.

- Public transit was considered dangerous, leading to ridership losses and disinvestments, although scientific evidence suggests that it is relatively safe (Levy 2020; Litman 2018; TUMI 2020; UITP 2020).
- Reduced vehicle traffic and physical distancing requirements justified street space reallocation to expand sidewalks and bike lanes, and create "open streets" where non-motorized modes share road space with low-speed motor vehicle traffic (Kostelec 2020; Lydon 2020; Schlossberg, et al. 2021).

- The pandemic increased walking and bicycling, particularly for recreational travel, and may justify more long-term pedestrian and bicycle facility improvements (Buehler and Pucher 2022)
- Telework (telecommunications and delivery services that substitute for physical travel) increased substantially as people and businesses gain experience with these technologies. One international study found that during the pandemic, working-at-home increased to 30% of workers whose jobs require physical interactions and 60-80% among information workers (Shibayama, et al. 2021).
- Vibrant and accessible communities (neighborhoods with walkable streets, nearby services and parks), emergency, service, freight and delivery vehicles received more recognition (Acuto and Hill 2021).
- Total crashes declined but traffic deaths increased in some countries, particularly in the US and Canada.

In 2020, U.S. vehicle travel declined 13% (Sivak 2021), which reduced total crashes and insurance claims by 15-25% (Carrns 2021), but increased traffic deaths 7% (Shepardson 2021; Vanlaar, et al. 2021), apparently because reduced congestion increased speeding and impaired driving (Kuntzma 2022; Stiles, et al. 2021). The figures below show increases in traffic exceeding speed limits during the lockdown period.

Exhibit 18 **UK Traffic Speed Compliance, Pandemic Period** (https://bit.ly/3vyNtbp)



The percentage of vehicles exceeding speed limits increased during the 2020 COVID-19 pandemic. This helps explain the increase in crash rates during this period.

(Based on UK DfT Vehicle Speed Compliance Statistics. Slide by Richard Owen, Agilysis)

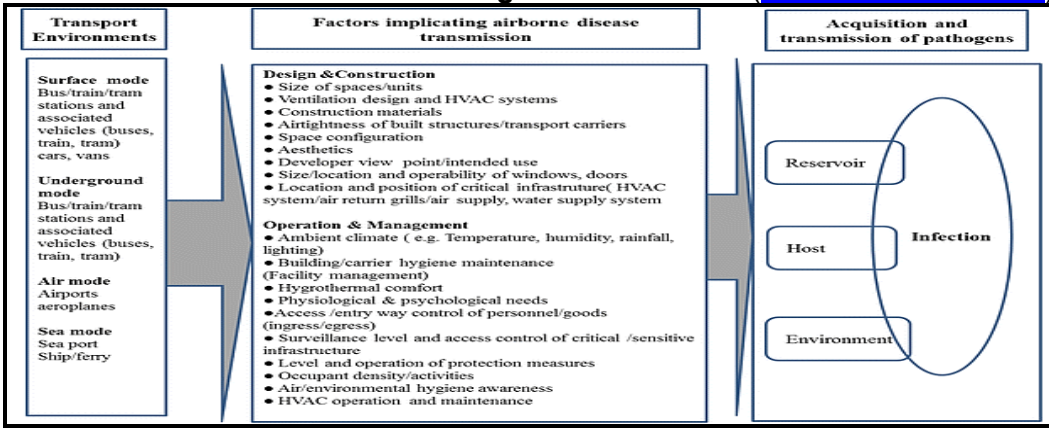
However, the U.S.'s increase in crash fatalities was an anomaly. In most countries traffic fatalities declined during 2020. The study, *Global Impact of COVID-19 Pandemic on Road Traffic Collisions* (Yasin, Grivna and Abu-Zidan 2021) found that, of 42 countries analyzed, in 2020 road death *declined* in 33 (25%+ in 5 countries, 15–24% in 13 countries, and 1-15% in 15 countries), and *increased* in 10 (Albania, Canada, Estonia, Finland, Ireland, Latvia, Luxembourg, Montenegro, Switzerland and USA) compared with previous years. Similarly, the International Transport Forum's *Road Safety Annual Report 2021: The Impact of Covid-19* (ITF 2021) found that of 34 countries with valid data, during 2020 traffic volumes declined on average -12.2% and road deaths declined 8.6% compared with previous years. Road deaths decreased on all types of roads including motorways (-19.9%), rural roads (-15%) and urban streets (-10%). The reductions in death were particularly large for young (under 17 years) and elderly (75+ years), with almost a quarter fewer fatalities. Fatality rates per billion vehicle-kilometres decreased slightly for the eleven countries that publish mobility data, with significant variations. For instance, crash rates declined 17% in Sweden but increases 12% in the Netherlands. This indicates that the relationships between vehicle travel and crashes is complex and can be overwhelmed by other factors such as traffic speed and risky driving.

During the pandemic, home location preferences shifted from urban to suburban neighborhoods (Parker, Horowitz and Minkin 2021). Will this cause people to abandon cities and public transit? Probably not. Perhaps the most relevant example is experience after the September 11th terrorist attack, and various public transit terrorist attacks (Reuters 2017). At the time, many people claimed that these events would end urbanization and public transit travel. Cities and transit agencies responded with increased security and public education. Both urbanization and transit ridership growth soon returned to previous levels. Although terrorist attacks lead some people to dread (have irrational fear of) cities and transit travel, they are, in fact, generally safer and healthier overall than rural living and automobile travel (Hamidi, et al 2018; Litman 2005). During a major pandemic it may be rational to limit transit travel but over the long run, total deaths and illnesses are likely to increase if exaggerated pandemic fear leads to long-term shifts from cities to automobile-dependent suburbs, or from public transit to automobile travel (Litman 2005).

Public Transit Contagion Risk and Risk Reduction

The article, *Airborne Biological Hazards and Urban Transport Infrastructure* (Nasir, et al. 2016) examines public transit contagion risks and risk reduction strategies. The following figure summarizes risk factors.

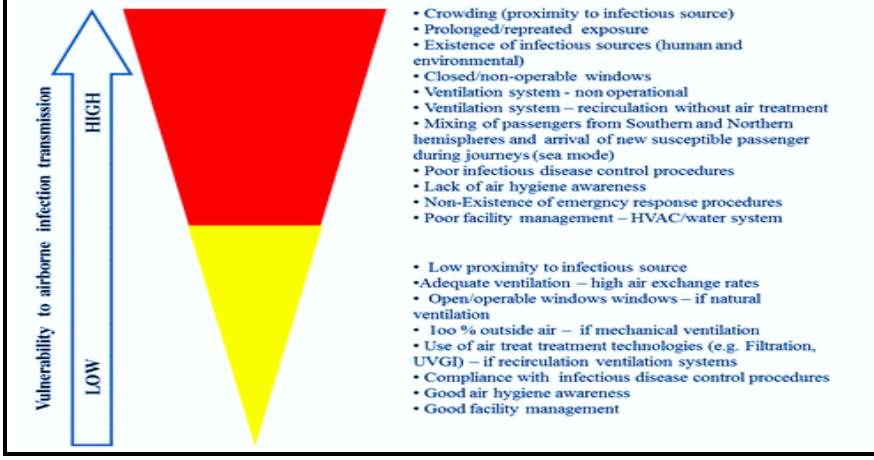
Exhibit 19 **Public Transit Contagion Risk Factors** (https://bit.ly/3oPWevL)



Public transit contagion risk varies by type of vehicle, air circulation rates, passenger density, ambient temperature, vehicle and building cleaning practices, and other factors.

Exhibit 20 indicates factors that affect public transit contagion vulnerability.

Exhibit 20 **Public Transit Contagion Vulnerability** (https://bit.ly/3oPWevL)



Public transit contagion risk increases with crowding, exposure duration, inadequate ventilation, passenger mix (such as visitors from areas with higher infection rates), plus inadequate infection monitoring and control.

Transit agencies can reduce risks by reducing crowding, improving ventilation, improving cleaning, and requiring or encouraging employees and passengers to wear masks.

Public transit operators can reduce employee and passenger contagion risks by:

- Reducing crowding.
- Improving ventilation in vehicles and stations.
- Improving vehicle and station cleaning.
- Requiring or encouraging employees and passengers to wear masks.
- Protecting operators with barriers, gloves and touchless payment systems.
- Monitor employee health and prevent employees from working if they are sick or exposed.

Transit agencies should also provide positive information and reassurances to employees and passengers concerning the relatively high safety of public transit travel, and encourage travellers to take measures to reduce risks such as wearing masks and sterilizing hands.

Resources for Reducing Transportation Pandemic Risks

APTA (2020), The COVID-19 Pandemic Public Transportation Responds: Safeguarding Riders and Employees, American Public Transportation Association (www.apta.com).

CNT (2020), *Urban Opportunity Agenda*, Center for Neighborhood Technology (www.cnt.org).

EU (2020), *COVID-19: Guidelines on the progressive restoration of transport services and connectivity*, European Union.

ITE (2020), *COVID-19 Resources*, Institute of Transportation Engineers (www.ite.org).

Polis (2020), *COVID-19: Keeping Things Moving*, Cities and Regions for Transport Innovation.

SLOCAT (2020), *COVID-19 and the Sustainable Transport Community*, Sustainable Low Carbon Transport Partnership.

Transit Center (2020), *How Transit Agencies Are Responding to the COVID-19 Public Health Threat*.

TUMI (2020), *The COVID-19 Outbreak and Implications to Sustainable Urban Mobility – Some Observations*, Transformative Urban Mobility Initiative (www.transformative-mobility.org).

UITP (2020), *Management of COVID-19 Guidelines for Public Transport Operators*, Union Internationale des Transports Publics (International Association of Public Transport); at (www.uitp.org).

WHO (2020), *Supporting Healthy Urban Transport and Mobility in the Context of COVID-19*, World Health Organization.

The study "Transit-Driven Resilience: Unraveling Post-COVID-19 Urban Recovery Dynamics" (Forouhar, et al. 2025) compared 2019 to 2023 economic recoveries between transit-oriented and other neighborhoods in Toronto, Canada. The results suggest that transit-oriented areas exhibited faster recovery than those farther away, reflecting associations with transit proximity, land-use and socio-economic diversity. The presence of industries such as accommodation, food services, arts, entertainment, healthcare, and education near transit stations proved to be more economically resilient while neighborhoods with more workplaces for sectors with remote work potential showed slower recovery. Proximity to jobs and essential amenities, walkability, and shorter commute times were also strongly associated with higher recovery rates. These findings indicate that integrating public transit with diverse land uses, socio-economic attributes, and equitable urban policies help create more sustainable and resilient communities.

Problems of Physical Distancing and Isolation

Pandemic control may require restrictions on travel, commercial and social activities, plus isolation and sometimes quarantine. The table below summarizes resulting problems and potential community solutions.

Exhibit 21 **Isolation Problems and Community Solutions**

Problem	Community Solutions
Confusion and fear	Good communication, particularly for vulnerable and isolated people.
Inadequate access to essential goods	Provide shopping opportunities, delivery services and teleshopping.
Healthcare needs	New service models, such as on-line consultations and pharmacy deliveries.
Crowding and discomfort	Adequate housing, with private outdoor space (balconies, decks, yards).
Mental stress	Community support and mental health services. Design for "sociable distancing."
Physical inactivity	Opportunities for outdoor activity. "Open streets" with restricted vehicle traffic.
Domestic conflicts	Adequate housing. Community support. Domestic violence response.
Reduced household income	Emergency funding. Community support. Affordability.
Reduced business income	Emergency funding. Support for new business models, such as delivery services.
Homelessness	Eliminate homelessness, as described in the following section.

Restrictions on travel, commercial and social interactions can create various problems.

Some of these solutions require technologies such as high-speed internet and video conferencing, plus delivery services, to help people to stay informed and entertained, access essential goods and services, work, and maintain social connections. Homes should have sufficient space and comfort features, natural light and air, and private outdoor spaces such as balconies, porches, decks and yards. Communities can be designed for "sociable distancing," for example, houses with windows oriented to the street, and front porches, plus wide sidewalks and recreational paths (Mehaffy 2020). These features are particularly important for families with children and people with disabilities.

Homelessness Risks and Solutions

People experiencing homelessness or inadequate housing, and the organizations that serve them, face special challenges from contagious diseases (Brasuell 2020). Homeless people tend to be vulnerable to infections due to a combination of daily stress, poor nutrition and chronic diseases, and living in crowded conditions that lack basic hygiene resources such as sinks, clean toilets, and opportunities to bath and clean clothes (Woodyard 2020). Homelessness services providers are also vulnerable to infectious illnesses and so may be unable to work during outbreaks.

Public health officials advise people exposed to or infected by contagious diseases to shelter in place. Such quarantines are difficult enough for people with stable homes and reliable incomes; they are virtually impossible for people who are homeless or living in inadequate housing (Fuller 2010), such as housing that is crowded, or lacks sufficient heating or cooling (DeParle 2020). If homeless people become infected, they will need to stay in hospitals, using scarce beds, adding stresses and costs to overburdened public health services. Everybody benefits by minimizing homeless residents' infection risks.

Many communities have programs to reduce homelessness, but pandemics make these efforts far more urgent. Homelessness service providers are working to reduce contagion risks, ensure physical distancing and improve hygiene (Woodyard 2020). Some communities are using RVs, tents or underutilized hotels to provide quarantine housing for homeless people who are infected but don't need hospitalization (Canales 2020). To be successful these efforts require coordinated food, healthcare and mental health services, with plans to transition occupants into stable long-term housing when the pandemic ends.

This is difficult. Homeless people have diverse abilities and needs. Although some are homeless temporarily, due to a short-term financial or domestic crisis, and simply need affordable housing, a portion is chronically homeless due to severe mental illness and substance abuse problems and so need housing with integrated medical, social and economic support. Such programs are costly but can be justified economically by their long-term health, social and economic benefits.

Homelessness problems are particularly severe in large central cities (DHUD 2018). Since homeless people tend to migrate from their home communities to those cities, called "social drift," regional, state/provincial and national governments should bear most of these costs (Lederbogen, Haddad, Meyer-Lindenberg 2013).

Resources for Addressing Homelessness Pandemic Risks

CDC (2020), *Interim Guidance for Homeless Shelters*, Center for Disease Control.

Homelessness Hub (2020), *Infectious Diseases*.

Jen Monnier (2020), "Coronavirus Poses Unique Threat to U.S. Homeless Population," *Scientific American*, 11 March.

NAEH (2020), *Coronavirus and Homelessness*, National Alliance to End Homelessness.

NCEH (2020), *What Homeless Folks Should Know about Coronavirus (COVID-19)*, National Coalition for the Homeless.

NHCHC (2020), *Coronavirus Resources*, National Health Care for the Homeless Council.

Affordability

The COVID-19 pandemic reduced many people's incomes, created severe economic problems for many households. Even before this pandemic, many low- and moderate-income households suffered from excessive housing, transportation and healthcare costs. Although stimulus funds, unemployment insurance, and bill deferment policies provided some relief, many households will need additional solutions.

Although affordability concerns often focus on high housing costs, many households also face excessive motor vehicle cost burdens, including occasional large unexpected expenses from mechanical failures and crashes. Many moderate-income households have difficulty making vehicle loan, insurance or repair payments and will need affordable mobility options.

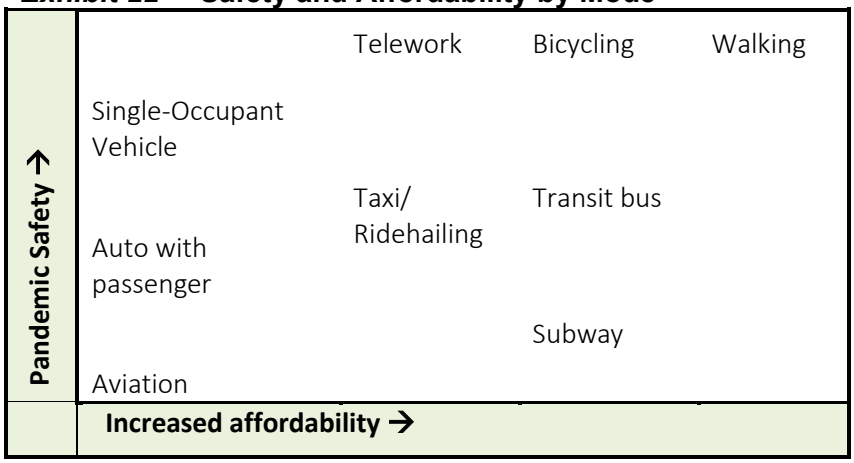
Below are local policies that can increase affordability:

1. Implement eviction protection, rent moratoriums and deferrals, plus subsidies for at risk households.
2. Increase allowable densities and building heights, and allow compact, missing middle housing types (secondary suites, multi-plexes, townhouses and low-rise apartments) in walkable urban neighborhoods, particularly for corner or larger lots, adjacent to parks, or on busier streets, since these locations minimize negative impact on neighbours.
3. Reduce development fees, approval requirements and inclusivity mandates for moderate-priced ($200,000-400,000 per unit) infill housing, since these are the projects we most need.
4. Reduce or eliminate parking minimums and favor unbundling (parking rented separately from housing units) so car-free households are not forced to pay for expensive parking facilities they do not need.
5. Allow higher densities and building heights in exchange for more affordable units. Minimum target densities can be applied in accessible locations, for example, at least three stories along minor arterials and four stories along major arterials.
6. Improve affordable housing design. Municipal governments can support design workshops and contests to encourage better design. The Affordable Housing Design Advisor, the Missing Middle Website, and Portland's Infill Design Project are examples of affordable housing design resources.
7. Improve active transport (walking and bicycling) and micro-mobility (electric scooters and bicycles) through improved sidewalks, crosswalks, bike lanes, complete streets policies, traffic calming and streetscaping.
8. Improve public transport services so vehicles and stations are less crowded, cleaner, better ventilated and less delayed, through better design, increased cleaning, dedicated bus lanes, all-door boarding, driver protection, and automated fare payments system, actions that improve convenience and comfort as well as reducing disease risks.
9. Implement Transportation Demand Management (TDM), which includes various policies and programs that encourage more efficient travel behavior. Local and regional governments can implement TDM strategies and require large employers to have Commute Trip Reduction programs.
10. Support development of walkable urban villages, called 15-minute neighborhoods, where most common services and activities are available within a 15 minute walk or 10-minute bike ride.

The figure below illustrates the estimated safety and affordability of various transportation modes. Active travel (walking and bicycling) provide the best combination. Some modes are safer but expensive, or affordable but relatively risky. Communities can increase resilience by improving the safe-affordable transportation options, and by reducing affordable mode risks (such as safer public transit), and increasing

the affordability of safer modes (such as improving telecommunications for lower-income households so they can telecommute.

Exhibit 22 **Safety and Affordability by Mode**



Transport modes vary in their pandemic safety and affordability. Of course, actual impacts will vary depending on conditions.

Pandemic-Resilient Community Planning

This section explores ways to design communities to minimize contagion risks and maximize health and safety.

A detailed study of urban public health reached the following conclusions:

> "High-density housing underpins compact cities, making proximate destinations and high frequency public transport viable. However, apartments with insufficient space, inflexible layouts, poor light, limited control over indoor air quality and temperature, and inadequate communal space might expose residents to environmental stressors (e.g., insufficient daylight or natural ventilation, poor thermal comfort, and lack of visual and acoustic privacy), impede physical distancing within and between households, and reduce ease of home-based activities (e.g., school, work, and exercise). The COVID-19 pandemic revealed and reinforced global inequities in housing. Densely populated low-income areas with underserviced housing were hotspots for disease spread. Overcrowded dwellings—rather than housing density per se—increases disease transmission risk, highlighting the urgent need for affordable and appropriate housing. Housing located along heavily trafficked roads or in areas with insufficient green space exposes residents to air pollution and noise, and exacerbates urban heat islands. Yet, affordable, low-density housing, located on the urban fringe and poorly served by amenities and public transport, increases urban sprawl, motor vehicle dependence, and social segregation." (Giles-Corti, et al. 2022)

Housing with ground-floor access – a private door that connects directly to a sidewalk or driveway – minimizes contagion risks. Multi-family buildings with exterior stairs and walkways also have low risk. Buildings with shared entranceways, indoor hallways and elevators are likely to present additional risks, but these can be reduced with frequent cleaning and sanitizing, as well as resident and employee hygiene. To minimize environmental risks homes should be built to withstand local risks such as earthquakes, hurricanes, extreme heat and cold, and located outside floodplains and wildfire interface.

Exhibit 23 **Pandemic Resilient Housing**

		
Townhouses with ground-floor access	*Apartments with exterior access.*	*Apartments with balconies.*

To reduce the isolation stress, homes need sufficient space and quiet, adequate light and ventilation, plus private outdoor areas such as a balcony or deck with seating, and, particularly for children, a yard or rooftop garden (Poon 2020; Zacka 2020). Home offices are desirable, particularly if household members work or study at home. Personal privacy is important, such as a home office or quiet workspace, particularly for home workers. Windows oriented to the street, and a front porch or low balcony, allow residents to wave and talk to neighbors while maintaining safe distances (sociable distancing).

A given density can be designed to have very different degrees of contagion risk, depending on pedestrian connectivity. For example, high-rise density tends to have low pedestrian connectivity, particularly if located in an automobile-dependent area were much of the land must be devoted to vehicle parking, while mid-rise density with numerous walkways can provide high connectivity which minimizes crowding and contagion risks, as illustrated to the right.

Mid-rise, pedestrian-oriented development tends to maximize community cohesion (the quality of interactions among neighbor) and livability. A recent article by planner Michael Mehaffy, *Why We Need 'Sociable Distancing',* shows how moderate-density, pedestrian-oriented development maximizes residents' ability to maintain social connections among homes, shops and pedestrians, which increases safety, health and happiness.

Exhibit 24 **Density and Connectivity**

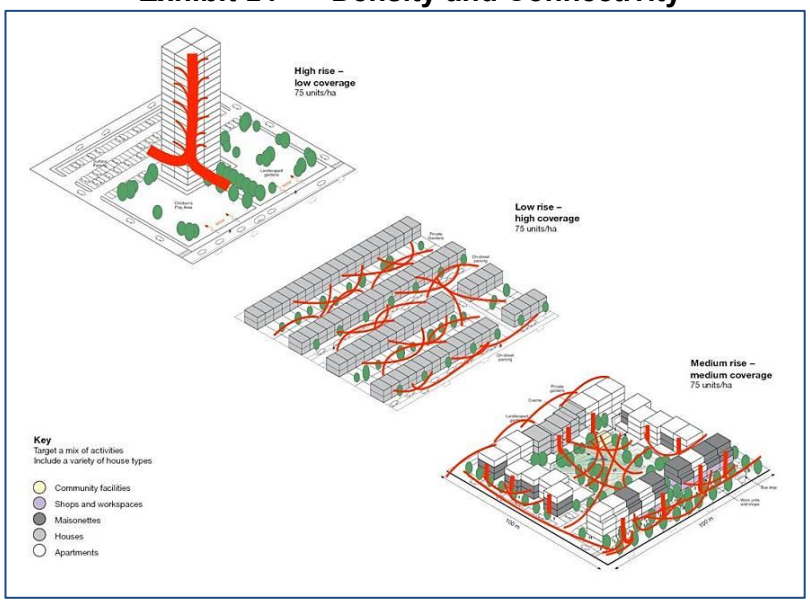


Exhibit 25 **Urban Space as a Web of Connections** (Mehaffy 2020)

Urban space is a complex web of places where we can be, move, see and hear, and therefore connect. This provides sociable distancing, where people can safely interact with minimal contagion risks.

The National Association of City Transportation Officials (NACTO) developed the *Rapid Response: Tools for Cities* and *Streets for Pandemic Response and Recovery* which describe ways that local governments can increase transport safety during this pandemic. These include prioritizing essential over non-essential travel, protecting front-line workers, and changing street design and management to provide more space and safety for pedestrians and bicyclists. *Rethinking Streets During COVID-19* (Schlossberg, et al. 2021), provides guidance on quick roadway redesigns to achieve physical distancing, public use and equity goals.

Exhibit 26 **Roadway Management for Pedestrian and Bicycle Safety** (NACTO 2020)

Many communities are changing streets to give pedestrians and bicyclists more space and safety.

The table below summarizes actions that households and communities can take to increase their resilience to pandemics and other economic, social and environmental shocks.

Exhibit 27 **Resilience Planning Checklists**

	Households	Communities
Reduces Pandemic Risks	• Resources to sanitize personal items, vehicles and homes, plus face masks and gloves. • A home with adequate space, home offices, natural light and ventilation, and private outdoor spaces such as a balcony, deck or yard to provide comfort for extended isolation. • Good communications resources, including telephone, internet service and computers for socializing, e-commerce and telework. • Fitness program, including in-home exercise and nearby walking and bicycling.	• Good public health programs, particularly infectious disease control and smoking reduction. • Healthcare services able to handle surges. • Shared vehicles (taxis, ridehailing and public transport) density restrictions, cleaning and sanitizing, plus employee and passenger hygiene. • Minimal homelessness or inadequate housing. • Programs to address mental illness, substance abuse, domestic violence, and vulnerable resident supports. • Expanded pedestrian facilities to prevent crowding, traffic calming and road space reallocation.
Reduces All Risks	• Household emergency plan, including emergency contact information. • Emergency supplies, including first aid equipment, flashlights, mobile phone and portable radio backup power, and food for at least two weeks. • A home in a relatively safe location (out of floodplains and wildfire interface) built to withstand local risks such as earthquakes, hurricanes, plus extreme heat and cold. • Comfortable shoes for walking and a sturdy bicycle for riding. • Housing in a compact, walkable and bikeable neighborhood where essential services and activities are accessible without a car. • Ways to reduce household expenditures if income declines. • Positive relationships with neighbors.	• Effective emergency management with trustworthy leadership, reliable communications networks and critical supplies. • Robust internet and telecommunications networks, e-government, e-commerce, and delivery services. • Restrictions on development in high-risk areas such as floodplains and wildfire interface. • Zoning codes and house retrofit programs that ensure homes can withstand local risks such as earthquakes, and extreme weather, and are energy efficient. • Compact, walkable and bikeable neighborhoods where most essential services and activities can be accessed without using an automobile. • Sufficient affordable housing to serve demand. • Community cohesion, so most residents have positive relationships with their neighbors. • Unemployment insurance and support for lower-income households.

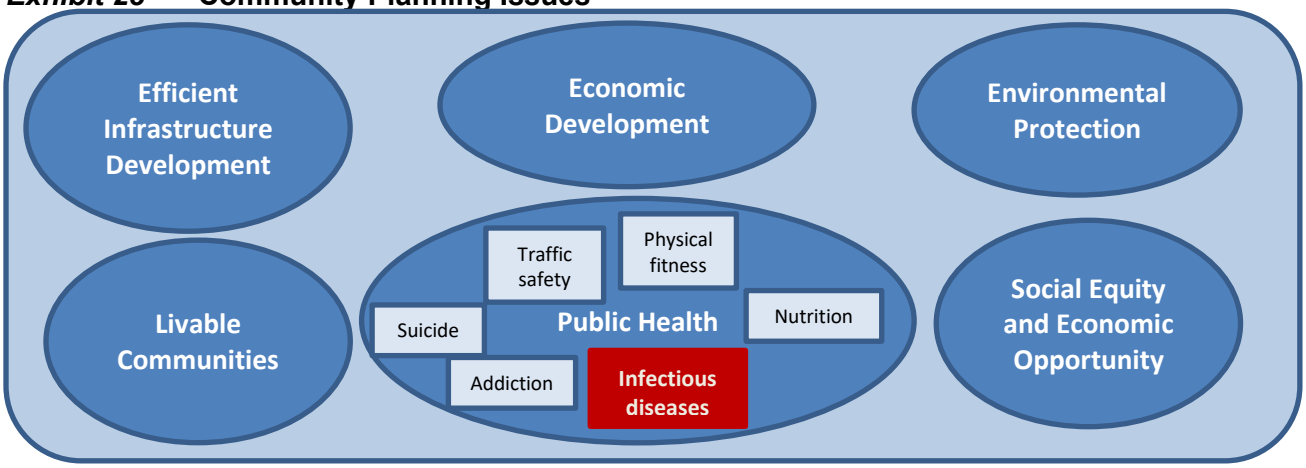
Good planning by households and communities can increase their resilience to pandemics and other risks.

This analysis indicates that, although affluent motorists may be healthy and happy in automobile-dependent areas, such locations impose significant costs and constraints: they require every adult to own a private vehicle, and offer poor mobility options for residents who cannot, should not, or prefer not to drive. In such areas, physical and digital access to essential services and activities is limited and expensive. For most households, the safest, healthiest and most resilient home is located in walkable urban neighborhood where commonly-used services and activities are easy to access on foot and by bicycle.

Comprehensive Solutions

Comprehensive planning recognizes that COVID-19 is just one type of infectious diseases, infectious disease reduction is just one public health objective, and improving public health is just one planning goal. A basic principle of good planning is that individual, short-term decisions should be consistent with strategic, long-term community goals. As a result, comprehensive planning favors "win-win" solutions that address pandemic problems and help achieve other community goals (Polis 2021; UN-Habitat 2021).

Exhibit 28 **Community Planning Issues**



Infectious diseases, including pandemics, are just one of many public health risks, and reducing these risks is one of many community goals. Comprehensive planning implements win-win solutions that help achieve multiple goals.

Many pandemic solutions help achieve other planning goals, as illustrated in the following matrix. For example, walking and bicycling improvements, reducing automobile travel and increasing affordable housing options helps achieve various health, social equity and environmental protection goals (Verma, et al. 2020). For example, the article *Treating Two Pandemics for the Price of One: Chronic and Infectious Disease Impacts of the Built and Natural Environment* (Frank and Wali 2021), finds that compact, walkable neighborhoods reduce infectious disease *and* chronic health problems such as cardiovascular illnesses.

Exhibit 29 **Benefits Provided by Various Policies**

Policy Solutions	Reduce Contagion	Public Health	Sustainability
Limit public gatherings and activities	✓		
Targeted cleaning and hygiene	✓	✓	
Improve public health and emergency services	✓	✓	
Walking and bicycling improvements	✓	✓	✓
Encourage public transport use		✓	✓
Reduce private auto travel		✓	✓
Reduce homelessness	✓	✓	✓
Affordable infill housing	✓	✓	✓
Traffic safety programs		✓	
Assist low-income households	✓	✓	✓

Policy solutions vary in their scope of benefits. Smart planning favors solutions that also help achieve multiple goals, such as pandemic control policies that support other public health and sustainability objectives.

Conclusions

A basic test of human intelligence is whether we learn from previous experiences and generalize those lessons to solve new problems. There is much to learn from the COVID-19 pandemic to better prepare for future pandemics and other health, social and economic threats.

Many people assume that cities are more dangerous than rural areas during a pandemic, but most contagion risks are associated with specific activities – long-distance travel, worksites, stores and social gatherings – that are similar in most communities. Although increased density can increase opportunities to spread germs, other factors have more effect on infection and mortality rates, so dense cities with good public health programs have lower risks than rural areas with poor public health programs. Overall, urban residents tend to be healthier and live longer than in rural areas.

To improve resilience, communities need effective emergency response programs, contagion control, adequate housing for all residents, physical and mental support for isolated people, and affordability. Homes can be designed to reduce quarantine stress, with adequate space, light and ventilation, and located in walkable neighborhoods. Homes with ground-floor access are safest, but risks can be minimized in multi-family housing with appropriate cleaning and sanitizing. Homelessness tends to increase contagion risks, so everybody is safer if it is eliminated. Intercity travel can introduce infections into a community, and local travel can disperse it. All shared vehicles can spread germs, including taxis, ridehailing, public transit, and private automobiles that carry family and friends. This suggests that to increase safety, residents should minimize shared vehicle travel, and shared vehicle operators and passengers should ensure appropriate distancing, sanitizing and hygiene practices. Walking and bicycling are generally the safest and most affordable modes, improve physical and mental health, and help reduce social isolation, so improving walking and bicycling conditions tends to increase resilience.

Pandemics are just one of many risks communities face, and generally not the most important, so it would be inefficient to implement contagious control strategies that increase other problems, for example, by reducing physical activity and social interactions, or increasing vehicle travel and therefore traffic casualties and pollution emissions.

Many "win-win" solutions can help reduce pandemic risks and achieve other community goals, such as increasing affordability, physical activity, and community livability, and reducing traffic problems and pollution emissions.

Exhibit 30 **Analysis Scope**

Risks	Analysis Question
1. **Infectious diseases pandemics**	How do pandemics compare with other risks? What factors affect these risks, and how can they be reduced?
2. **Disaster risks**	How do disasters compare with other risks? How can communities minimize disaster deaths, injuries and damages?
3. **Health risks**	How do various health risk compare? What factors affect community health and longevity, and how can they be maximized?
4. **Economic, social and environmental impacts**	How does health compare with other community goals? What trade-offs exist between these goals? What win-win strategies provide multiple benefits?

Resilience analysis can vary in scope. Good planning requires broad analysis that compares pandemics with other disasters, other health risks, and other economic, social, and environmental impacts.

References

Michele Acuto and Dan Hill (2022), *From Fix to Fixture: Which COVID-Driven Urban Innovations Are Here to Stay for the Long Term?*, Covid and Society (https://covidandsociety.com); at https://bit.ly/3zIlmZq.

Emily Badger (2020), "Density Is Normally Good for Us. That Will be True after Coronavirus, Too," *New York Times*, 24 March, (www.nytimes.com); at https://nyti.ms/2UUrVE8.

Laura Bliss and Kriston Capps (2020), *Are Suburbs Safer From Coronavirus? Probably Not*, City Labs (www.citylab.com); at https://bit.ly/2X2o36A.

James Brasuell (2020), *The Crisis Within the Crisis: Homelessness and Housing Pushed to the Brink by COVID-19*, Planetizen (www.planetizen.com/node/108864).

Ralph Buehler and John Pucher (2022), "Cycling through the COVID-19 Pandemic to a More Sustainable Transport Future," *Sustainability*, Vo. 14(12), 7293 (https://doi.org/10.3390/su14127293).

Katie Canales (2020), "San Francisco Will Temporarily House Members of its Homeless Population Who are Infected with the Coronavirus in RVs," *Business Insider*, 11 March; at https://bit.ly/2WZXKOq.

Ann Carrns (2021), "Pandemic Driving Is Still Down, but Will Insurers Grant More Relief?" *New York Times* (www.nytimes.com); at www.nytimes.com/2021/01/01/your-money/covid-driving-car-insurance.html.

Felipe Carozzi, Sandro Provenzano and Sefi Roth (2020), *Urban Density and Covid-19*, Paper 1711, Centre for Economic Performance (https://cep.lse.ac.uk); at https://cep.lse.ac.uk/pubs/download/dp1711.pdf.

CEBM (2020), *Global COVID-19 Case Fatality Rates*, Centre for Evidence-Based Medicine (www.cebm.net); at www.cebm.net/COVID-19/global-COVID-19-case-fatality-rates.

Siddharth Chandra, et al. (2013), "A Geographic Analysis of Population Density Thresholds in the Influenza Pandemic of 1918–19," *International Journal of Health Geography*, Vol. 12, 9 (https://doi.org/10.1186/1476-072X-12-9).

Cities for Global Health (www.citiesforglobalhealth.org) shares information concerning how local and regional governments are effectively responding to the COVID pandemic.

Arthur G. Cosby, et al. (2019), "Growth and Persistence of Place-Based Mortality in the United States: The Rural Mortality Penalty," *American Journal of Public Health*, Vo. 109, 1, pp. 155-162 (doi:10.2105/AJPH.2018.304787); at www.ncbi.nlm.nih.gov/pmc/articles/PMC6301407.

Benjamin D. Dalziel, et al. (2018), "Urbanization and Humidity Shape the Intensity of Influenza Epidemics in U.S. Cities," *Science*, Vol. 362/6410, pp. 75-79 (DOI: 10.1126/science.aat6030).

Irvin Dawin (2020), *Density in the Pandemic Era*, Planetizen (www.planetizen.com); at www.planetizen.com/news/2020/03/108778.

Jason DeParle (2020), "The Coronavirus Class Divide: Space and Privacy," *The New York Times*, 12 April; at www.nytimes.com/2020/04/12/us/politics/coronavirus-poverty-privacy.html.

DHUD (2018), *Annual Homeless Assessment Report (AHAR) to Congress*, US Department of Housing and Urban Development; at www.novoco.com/sites/default/files/atoms/files/hud_ahar_2018_121718.pdf.

Jake Dobkin and Clarisa Diaz (2020), *Coronavirus Statistics: Tracking the Epidemic in New York*, The Gothamist (https://gothamist.com); at https://bit.ly/34uSeoO.

Reid Ewing and Shima Hamidi (2015), "Compactness Versus Sprawl: A Review of Recent Evidence from the United States," *Journal of Planning Literature*, Vol. 30, pp. 413-432 (doi: 10.1177/0885412215595439).

Yingling Fan and Yan Song (2009), "Is Sprawl Associated with a Widening Urban–Suburban Mortality Gap?," *Journal of Urban Health*, Vo. 86, pp. 708–728 (doi: 10.1007/s11524-009-9382-3); at https://bit.ly/2yUHyny.

Kim Fletcher, et al. (2014), *A Guide for Public Transportation Pandemic Planning and Response*, National Academies Press (https://doi.org/10.17226/22414).

Amir Forouhar, et al. (2025), "Transit-Driven Resilience: Unraveling Post-COVID-19 Urban Recovery Dynamics," *Journal of Transport Geography*, Vo. 128 (https://doi.org/10.1016/j.jtrangeo.2025.104327).

Justin Fox (2020), "Density Isn't Destiny in the Fight Against COVID-19," *Bloomberg News* (www.bloomberg.com); at https://bloom.bg/3ehxbui.

Lawrence D. Frank and Behram Wali (2021), "Treating Two Pandemics for the Price of One: Chronic and Infectious Disease Impacts of the Built and Natural Environment," *Sustainable Cities and Society*, Vo. 73 (https://doi.org/10.1016/j.scs.2021.103089).

Chad Frederick, Anna Hammersmith and John Hans Gilderbloom (2019), "Putting 'Place' in its Place: Comparing Place-based Factors in Interurban Analyses of Life Expectancy in the U.S.," *Social Science & Medicine*, Vo. 232, pp. 148-155 (doi.org/10.1016/j.socscimed.2019.04.047); at https://bit.ly/2REhmUG.

Thomas Fuller (2020), *Coronavirus Outbreak Has America's Homeless at Risk of 'Disaster'*, *New York Times* 12 March; at www.nytimes.com/2020/03/10/us/coronavirus-homeless.html.

Salim Furth (2020), *Automobiles Seeded the Massive Coronavirus Epidemic in New York City*, Market Urbanism (https://marketurbanism.com); at https://bit.ly/2VwKhg1.

Billie Giles-Corti, et al. (2022), "What Next? Expanding Our View of City Planning and Global Health, and Implementing and Monitoring Evidence-Informed Policy," *Lancet Global Health*, Vo. 10, No. 6 (www.thelancet.com/series/urban-design-2022); at https://bit.ly/3afO9vL.

Aaron Gordon (2020), *It's Easy, But Wrong, to Blame the Subway for the Coronavirus Pandemic*, Motherboard (www.vice.com); at https://bit.ly/2RVDppZ.

Henry Grabar (2020), "Nothing about New York's Outbreak was Inevitable," *Slate* (https://slate.com); at https://slate.com/business/2020/04/coronavirus-new-york-city-outbreak-blame.html.

Shima Hamidi, et al. (2018), "Associations between Urban Sprawl and Life Expectancy in the U.S.," *Int. Jn. of Environmental Research and Public Health*, Vol. 15/5 (doi:10.3390/ijerph1505086); at https://bit.ly/2Ni4L5i.

Shima Hamidi, Sadegh Sabouri and Reid Ewing (2020), "Does Density Aggravate the COVID-19 Pandemic?" *Journal of the American Planning Association* (DOI: 10.1080/01944363.2020.1777891).

Victoria Hansen, et al. (2016), "Infectious Disease Mortality Trends in the United States, 1980-2014," *Journal of the American Medical Association*, Vol. 316, No 20, pp. 2149-2151 (doi:10.1001/jama.2016.12423); at https://jamanetwork.com/journals/jama/fullarticle/2585966.

Jeffrey E. Harris (2020), *The Subways Seeded the Massive Coronavirus Epidemic in New York City*, Working Paper 27021, National Bureau of Economic Research (www.nber.org); at www.nber.org/papers/w27021.

Jack Healy, et al. (2020), "Coronavirus Was Slow to Spread to Rural America. Not Anymore," *New York Times*, 8 April (www.nytimes.com); at https://nyti.ms/2UXVoyk.

Sophia Heisler (2020), *Where and When Local Travel Decreased from COVID-19 Around the World*, Map Box (https://mapbox.com); at https://bit.ly/3aGqCiS.

Seyed Jafar Hejazi, et al (2023), "Measuring the Effects of Compactness/Sprawl on COVID 19 Spread Patterns at the Neighborhood Level," *Cities*, Vo. 132 (https://doi.org/10.1016/j.cities.2022.104075).

Ben Holland (2020), *Coronavirus and the Fragility of Auto-Centric Cities*, Rocky Mountain Institute (https://rmi.org); at https://rmi.org/coronavirus-and-the-fragility-of-auto-centric-cities.

Jeremy Hsu (2020), "Population Density Does Not Doom Cities to Pandemic Dangers," *Scientific American* (www.scientificamerican.com); at https://bit.ly/2ZNptm3.

Youqin Huang and Rui Li (2022), "The Lockdown, Mobility, and Spatial Health Disparities in COVID-19 Pandemic: A Case Study of New York City," *Cities*, Vo. 122 (https://doi.org/10.1016/j.cities.2021.103549).

ITDP (2020), *Density is Not the Problem: COVID-19 and Cities*, Institute for Transportation and Development Policy (www.itdp.org); at https://bit.ly/36JklUu.

ITF (2021), *Road Safety Annual Report 2021: The Impact of Covid-19*, International Transport Forum (www.itf-oecd.org); at www.itf-oecd.org/road-safety-annual-report-2021.

Maxine Joselow (2020), "There Is Little Evidence that Mass Transit Poses a Risk of Coronavirus Outbreaks," *Scientific American* (www.scientificamerican.com); at https://bit.ly/3jMesZD.

Dan Keating and Laris Karklis (2020), "Rural Areas May be the Most Vulnerable during the Coronavirus Outbreak," Washington Post, 19 March (www.washingtonpost.com); at https://wapo.st/346UX7r.

Roger Keil, Creighton Connolly and S. Harris Ali (2020), "Outbreaks Like Coronavirus Start in and Spread from the Edges of Cities," *The Conversation* (https://theconversation.com); at https://bit.ly/2UGjjlJ.

Amir Reza Khavarian-Garmsir, Ayyoob Sharifi and Nabi Moradpour (2021), "Are High-density Districts more Vulnerable to the COVID-19 Pandemic?" *Sustainable Cities and Society*," Vo. 70 (doi.org/10.1016/j.scs.2021.102911).

Don Kostelec (2020), *Maintaining Social Distance along Substandard Sidewalks & Pathways*, Kostelec Planning (www.kostelecplanning.com); at https://bit.ly/2ULSX1u.

Gersh Kuntzma (2022), *Bad to Worse: Study Explains Why Road Violence Increased During the Pandemic*, StreetBlog USA (https://usa.streetsblog.org); at https://bit.ly/3KpCkjp.

Andrew Leonard (2020), "Taiwan Is Beating the Coronavirus. Can the US Do the Same? *Wired*, 18 March (www.wired.com) www.wired.com/story/taiwan-is-beating-the-coronavirus-can-the-us-do-the-same.

Florian Lederbogen, Leila Haddad and Andreas Meyer-Lindenberg (2013), "Urban Social Stress – Risk Factor for Mental Disorders. The Case of Schizophrenia," *Environmental Pollution*, (http://dx.doi.org/10.1016/j.envpol.2013.05.046); at https://bit.ly/2DXKrpb.

Alon Levy (2020), *The Subway is Probably not Why New York is a Disaster Zone*, Pedestrian Observations (https://pedestrianobservations.com); at https://bit.ly/2VkZ0ut.

Alon Levy and Eric Goldwyn (2020), *How U.S. Public Transit Can Survive Coronavirus*, City Lab (www.citylab.com); at https://bit.ly/35bvB9l.

Ruiqi Li, Peter Richmond and Bertrand M. Roehner (2018), "Effect of Population Density on Epidemics," *Physica A*, Vol. 510, pp. 713-724 (doi.org/10.1016/j.physa.2018.07.025); at https://bit.ly/2R9TFn5.

Bill Lindeke (2020), *It's Not Density That's Driving the American Pandemic*, Streets MN (https://streets.mn); at https://streets.mn/2020/03/24/its-not-density-thats-driving-the-american-pandemic.

Todd Litman (2005), "Terrorism, Transit and Public Safety: Evaluating the Risks," *Journal of Public Transit*, Vol. 8, No. 4 (www.nctr.usf.edu/jpt/journal.htm), pp. 33-46.; at www.vtpi.org/transitrisk.pdf.

Todd Litman (2018), *Evaluating Public Transportation Health Benefits*, American Public Transportation Association (www.apta.com); at www.vtpi.org/tran_health.pdf.

Todd Litman (2019), *Understanding Smart Growth Savings*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/sg_save.pdf.

Todd Litman (2020), *Planning Healthy Communities—Beyond the Hype*, Planetizen (www.planetizen.com); at www.planetizen.com/blogs/108789-planning-healthy-communities-beyond-hype.

Melissa Lunden and Meghan Thurlow (2020), *The Stunning Impact of COVID-19 Social Distancing on Air Pollution*, GreenBiz (www.greenbiz.com); at https://bit.ly/2VfFFt8.

Mike Lydon (2020), *Let's Not Overthink This: Opening Streets is Easy*, Streetsblog USA (https://usa.streetsblog.org); at https://bit.ly/34KI3MK.

Michael Mehaffy (2020), "Why We Need 'Sociable Distancing'", *The Public Square*, Congress for New Urbanism (www.cnu.org); at https://bit.ly/2Xpb1Af.

NACTO (2020), *Rapid Response: Tools for Cities*, National Association of City Transportation Officials (www.nacto.org); at https://nacto.org/covid19-rapid-response-tools-for-cities.

NACTO (2020), *Streets for Pandemic Response and Recovery*, National Association of City Transportation Officials (www.nacto.org); at https://nacto.org/streets-for-pandemic-response-recovery.

Zaheer A. Nasir, et al. (2016), "Airborne biological hazards and urban transport infrastructure : current challenges 4 and future directions," *Environmental Science and Pollution Research*, Vo. 16, pp. 15757–15766 (https://doi.org/10.1007/s11356-016-7064-8).

Dennis Normile (2020), "Coronavirus Cases have Dropped Sharply in South Korea. What's the Secret to its Success?" *Science*, 17 March (www.sciencemag.org); at https://bit.ly/39wxa29.

Kim Parker, Juliana Menasce Horowitz and Rachel Minkin (2021), *Americans are Less Likely than Before COVID-19 to Want to Live in Cities, More Likely to Prefer Suburbs*, Pew Center (www.pewresearch.org); at https://pewrsr.ch/3p4u0gS.

PHSD (2018), *Leading Causes of Death*, Public Health Sudbury (www.phsd.ca); at https://bit.ly/39ylVpD.

POLIS (2021), *Topic Guide: Planning for More Resilient and Robust Urban Mobility*, European Platform on Sustainable Urban Mobility Plans (www.eltis.org); at https://bit.ly/2MQmR3C.

Linda Poon (2020), *A Lesson from Social Distancing: Build Better Balconies*, City Lab (www.citylab.com); at www.citylab.com/life/2020/04/apartment-design-balcony-private-outdoor-space-zoning-laws/610162.

Benjamin Rader, et al. (2020), "Crowding and the Shape of COVID-19 epidemics," *Nature Medicine* (https://doi.org/10.1038/s41591-020-1104-0).

Reuters (2017), *Factbox: Attacks on Mass Transit Around the World*; at https://reut.rs/39MRGM9.

Hannah Ritchie and Max Roser (2020), *Natural Disasters*, OurWorldInData; at https://bit.ly/33vn9F2.

Philipp Rode (2021), *Can Cities be Hyperlocal?*, London School of Economics (https://lse.ac.uk); at https://blogs.lse.ac.uk/covid19/2021/10/01/can-cities-be-hyperlocal.

Louis Sahagun (2020), "Coronavirus Stay-At-Home Orders have Reduced Traffic Accidents by Half," *Los Angeles Times*, 1 April (www.latimes.com); at https://lat.ms/2xIrCUK.

James F. Sallis, et al. (2016), "Physical Activity in Relation to Urban Environments in 14 Cities Worldwide: A Cross-Sectional Study," *The Lancet*, Vol. 387, pp. 2207–2217; at https://bit.ly/1RSchnU.

Sam Swartz Consulting (2020), *Public Transit and COVID-19 Pandemic: Global Research and Best Practices*, American Public Transportation Association (www.apta.com); at https://bit.ly/3kjhgAI.

Marc Schlossberg, et al. (2021), *Rethinking Streets During COVID-19*, University of Oregon's Sustainable Cities Institute (https://sci.uoregon.edu); at https://bit.ly/3u44I2S.

David Shepardson (2021), *U.S. Traffic Deaths up During Pandemic Even Though Mileage Down -Data*, Reuters (www.reuters.com); at https://reut.rs/31M1xU7.

Takeru Shibayama, et al. (2021), "Impact of COVID-19 Lockdown on Commuting; A Multi-country Perspective," *European Journal of Transport and Infrastructure Research*, Vo. 21/1 (https://journals.open.tudelft.nl/ejtir/index); at https://journals.open.tudelft.nl/ejtir/article/view/5135.

Shuaishuai Han, Changhong Miao and Baozhu Zhang (2023), "Impact of Density on the COVID-19 Pandemic: Evidence from Chinese Cities," *Cities*, Vo. 142 (https://doi.org/10.1016/j.cities.2023.104534).

Gopal K. Singh and Mohammad Siahpush (2014), "Widening Rural-Urban Disparities in Life Expectancy, U.S., 1969-2009," *American Journal of Preventive Medicine*, Vo. 46(2), pp. 19-29 (doi:10.1016/j.amepre.2013.10.017); at www.ajpmonline.org/article/S0749-3797(13)00590-4/fulltext.

Gopal K. Singh and Mohammad Siahpush (2014b), "Widening Urban-Rural Disparities in All-cause Mortality and Mortality from Major Causes of Death in the USA, 1969-2009, *Journal of Urban Health*, Vo. 91(2): 272-292 (doi: 10.1007/s11524-013-9847-2); at www.ncbi.nlm.nih.gov/pmc/articles/PMC3978153.

Michael Sivak (2021), *Monthly Changes in Key Transportation Indexes*, Green Car Congress (www.greencarcongress.com); at https://bit.ly/3rPLZcM.

SLOCAT (2020), *COVID-19 and the Sustainable Transport Community*, Sustainable Low Carbon Transport Partnership (https://slocat.net); at https://bit.ly/2ZEi8Wh.

Noah Smith (2020), "New York is a Hot Zone but Not Because of City Living," *Bloomberg News*, (www.bloomberg.com); at https://bloom.bg/3aCpXyD.

Robert Steuteville (2020), "Facts Don't Support the 'Density Is Dangerous' Narrative," *Public Square (*www.cnu.org); at www.cnu.org/publicsquare/2020/03/23/plague-don%E2%80%99t-count-cities-out.

Jonathan Stiles, et al. (2021), "Lower Volumes, Higher Speeds: Changes to Crash Type, Timing, and Severity on Urban Roads from COVID-19 Stay-at-Home Policies," *Transportation Research Record* (DOI: 10.1177/03611981211044454); at www.sciencedaily.com/releases/2021/09/210928102251.htm.

Rajendra Subedi, T. Lawson Greenberg and Shirin Roshanafshar (2019), *Does Geography Matter in Mortality?*, Statistics Canada (www.doi.org/10.25318/82-003-x201900500001-eng).

Transit Center (2020), *How Transit Agencies Are Responding to the COVID-19 Public Health Threat*, (https://transitcenter.org); at https://bit.ly/2X2Ch7I.

TUMI (2020), *The COVID-19 Outbreak and Implications to Sustainable Urban Mobility – Some Observations*, Transformative Urban Mobility Initiative (www.transformative-mobility.org); at https://bit.ly/3dLQ6gq.

UITP (2020), *Management of COVID-19 Guidelines for Public Transport Operators*; Union Internationale des Transports Publics (International Association of Public Transport) (www.uitp.org); at www.uitp.org/sites/default/files/cck-focus-papers-files/Corona%20Virus_EN.pdf.

UN-Habitat (2021), *Cities and Pandemics: Towards a More Just, Green and Healthy Future*, United Nations Habitat Program (https://unhabitat.org); at https://bit.ly/3ggkzXK.

W.G.M. Vanlaar, et al. (2021), "The impact of COVID-19 on road safety in Canada and the United States,"

Accident Analysis & Prevention, Vo 160 (https://doi.org/10.1016/j.aap.2021.106324).

Ashish Verma, et al. (2020), *The Curious Case of Transportation Systems in a Post COVID-19 World: A Summary of Impacts*, SSRN (http://dx.doi.org/10.2139/ssrn.3698006).

Robert Verity, et al. (2020), "Estimates of the Severity of Coronavirus Disease 2019: A Model-Based Analysis," *The Lancet* (https://doi.org/10.1016/S1473-3099(20)30243-7).

Behram Wali and Lawrence D. Frank (2021), "Hospitalizations and Mortality Relationships with Built Environment, Active and Sedentary Travel," *Health & Place* (doi.org/10.1016/j.healthplace.2021.102659).

Sarah Weilant, Aaron Strong and Benjamin M. Miller (2019), Incorporating Resilience into Transportation Planning and Assessment, Rand Corporation (www.rand.org); at https://bit.ly/3GDqeky.

WHO (2020), *Supporting Healthy Urban Transport and Mobility in the Context of COVID-19*, World Health Organization (www.who.int); at www.who.int/publications/i/item/9789240012554.

WHO (2022), *Emergency Dashboard: United States of America Situation*, World Health Organization (www.who.int); at https://covid19.who.int/region/amro/country/us.

Steve Winkelman (2020), *Mobilizing Against COVID-19 (by Staying Put)*, Green Resilience (www.greenresilience.com); at www.greenresilience.com/covid-climate-transport.

Chris Woodyard (2020), "Why the Homeless, 'Surviving the Best Way They Can,' Are Vulnerable to Coronavirus," *USA Today*, 14 March 2010 (www.usatoday.com); at https://bit.ly/39uCmmT.

Katherine J. Wu (2020), "What Scientists Know About Immunity to the Novel Coronavirus," *Smithsonian Magazine*; at www.smithsonianmag.com/science-nature/can-you-become-immune-sars-cov-2-180974532.

Yand Yang, et al. (2021), "Urban design attributes and resilience: COVID-19 evidence from New York City," *Buildings and Cities*, Vo. 2(1), pp. 618–636 (DOI: http://doi.org/10.5334/bc.130).

Yasin J. Yasin, Michal Grivna and Fikri M. Abu-Zidan (2021), "Global Impact of COVID-19 Pandemic on Road Traffic Collisions, *World Journal of Emergency Surgery*, Vo. 16, 51 (doi.org/10.1186/s13017-021-00395-8).

Bernardo Zacka (2020), "An Ode to the Humble Balcony," *New York Times* (www.nytimes.com); at www.nytimes.com/2020/05/09/opinion/covid-balconies-architecture.html.

Xiaomeng Zhang, et al. (2022), "Compact Cities and the Covid-19 Pandemic: Systematic Review of the Associations Between Transmission of Covid-19 or Other Respiratory Viruses and Population Density or Other Features of Neighbourhood Design, *Health & Place* (doi.org/10.1016/j.healthplace.2022.102827).