

Pandemic-Resilient Community Planning

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

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By Todd Litman

Victoria Transport Policy Institute



Resilient communities can efficiently absorb 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 pandemics and other disasters. 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, planners should help operators and travelers 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.

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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.

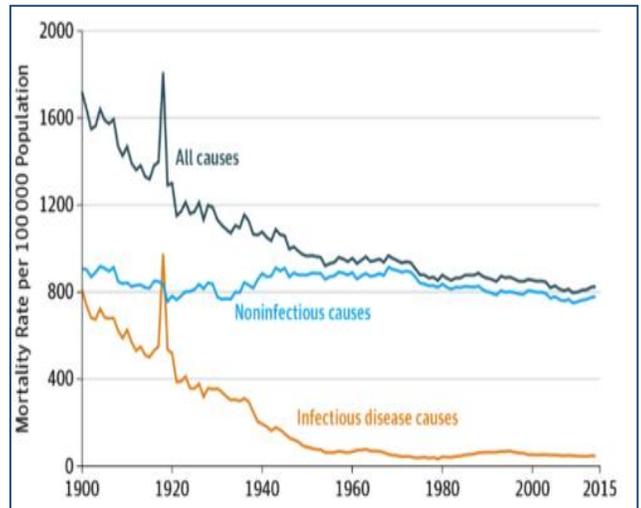
Similarly, imagine that you are a public official who received a similar prediction. How would you prepare your community? You would probably enhance your emergency management and healthcare programs, inventory emergency supplies, ensure that healthcare services can accommodate demand surges, implement 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.

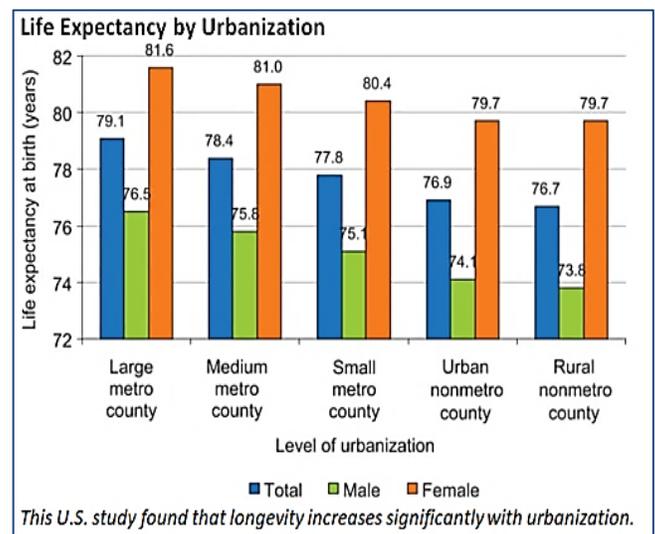
Infectious diseases are major risks. They can kill millions of people and impose huge economic costs. Fortunately, improved hygiene, vaccinations, healthcare, and other public health interventions have greatly reduced their mortality rates, as illustrated at right. Pandemics now kill fewer people, and 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	<ul style="list-style-type: none"> • Crowded buildings and sidewalks • Elevators • Public transit • Homelessness and inadequate housing 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Targeted cleaning • Promote hygiene rules • Promote social distancing • Improve walking and bicycling • Eliminate homelessness and improve housing quality 	<ul style="list-style-type: none"> • 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.

Safety and Affordability by Mode				
Pandemic Safety →	Single-Occupant Vehicle	Telework	Bicycling	Walking
		Auto with passenger	Taxi/ Ridehailing	Transit bus
	Aviation		Subway	
	Increased affordability →			

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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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; if uncontrolled it could kill many millions of people around the world. Fortunately, public health interventions have reduced its spread and deaths. Thanks, public 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
<i>Pandemic</i>	<i>Very Large</i>	<i>Very Long</i>	<i>Long</i>	<i>Very Large</i>	<i>None</i>	<i>Very Large</i>	<i>None</i>

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.

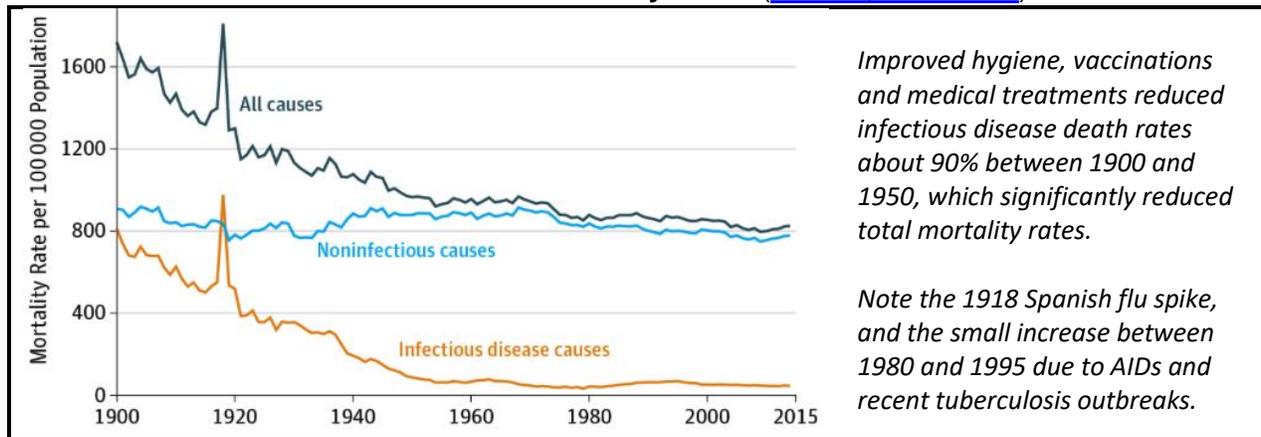
These principles can be applied to many types of planning decisions. For example, this suggests that to increase resilience, households should choose homes, and communities should design neighborhoods, that are in lower-risk locations, with efficient and redundant public infrastructure, and build multi-modal 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

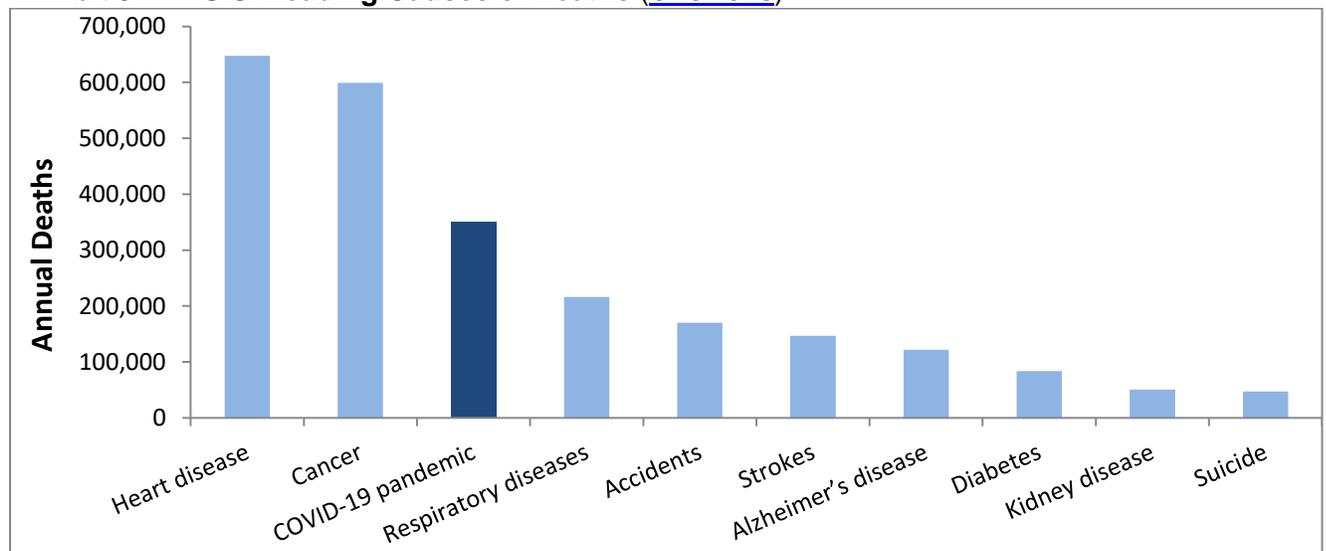
Infectious disease epidemics, including smallpox, typhus, plague, cholera, polio, and measles, were once common and deadly ([Healthline 2016](#)). Fortunately, better hygiene, vaccines, and improved medical treatments greatly reduced these risks, as illustrated below. Globalization increases contagion dispersion but also the speed of responses, 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](#))



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 2020 it caused at least 350,000 deaths in the U.S. (probably more) and is predicted to kill 500,000 or more before the pandemic ends ([Fritze 2020](#); [Kristof 2020](#)). Because COVID-19 tends to kill older people, it causes smaller reductions in [Potential Years of Life Lost \(PYLLs\)](#), which 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.

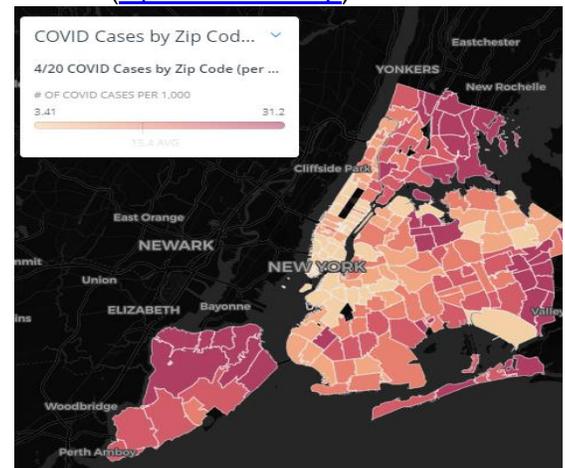
Comparing Risks by Location

Health risks vary by location ([Badger 2020](#)). Many people assume that contagion risk increases with development density, making cities dangerous ([Dawid 2020](#); [Rosenthal 2020](#)), but this is generally untrue ([Fox 2020](#); [Smith 2020](#); [Steuteville 2020](#)). For this analysis, it is important to distinguish between *density* (people per acre) and *crowding* (the number of people in an enclosed space, such as a vehicle or house). Contagion risks results from crowding, not density ([Yang, et al. 2021](#)). There is no reason to believe that worksites, stores, and healthcare facilities are more contagious in cities than suburban and rural areas. Although infection exposure tends to increase with density, other factors, such as travel behavior and healthcare quality are more important, so cities with good public health programs have lower infection and fatality rates than sprawled areas with poor programs ([Li, Richmond and Roehner 2018](#)).

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. High 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](#)). 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](#); [Lewyn 2020](#)), as illustrated right.

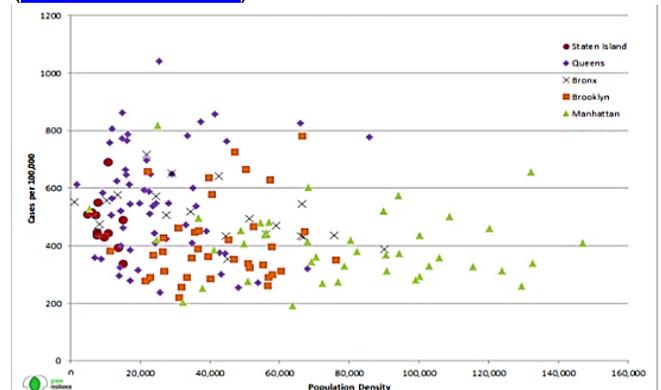
Using sophisticated statistical analysis, Wali and Frank ([2021](#)) found that in the Seattle, Washington region, COVID hospital and fatality rates increased with sedentary travel and declined with active travel (walking and bicycling), and were lower in more mixed and connected neighborhoods. [Hamidi, 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. 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. Similarly, [Khavarian-Garmsir, Sharifi and Moradpour \(2021\)](#) found that in Tehran, infection rates were negatively associated with income but unaffected by density. The figure to the right, from *Mobilizing Against COVID-19 (by Staying Put)*, shows the negative relationship between neighborhood density and COVID-19 infection rates in New York City.

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.

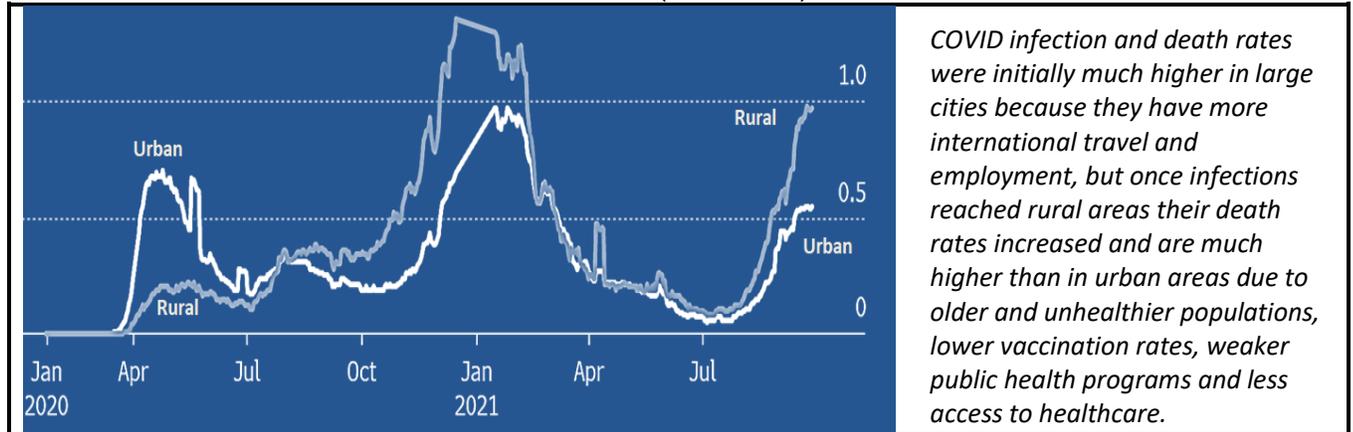
Exhibit 5 NYC COVID-19 Versus Density ([Winkelmann 2020](#))



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

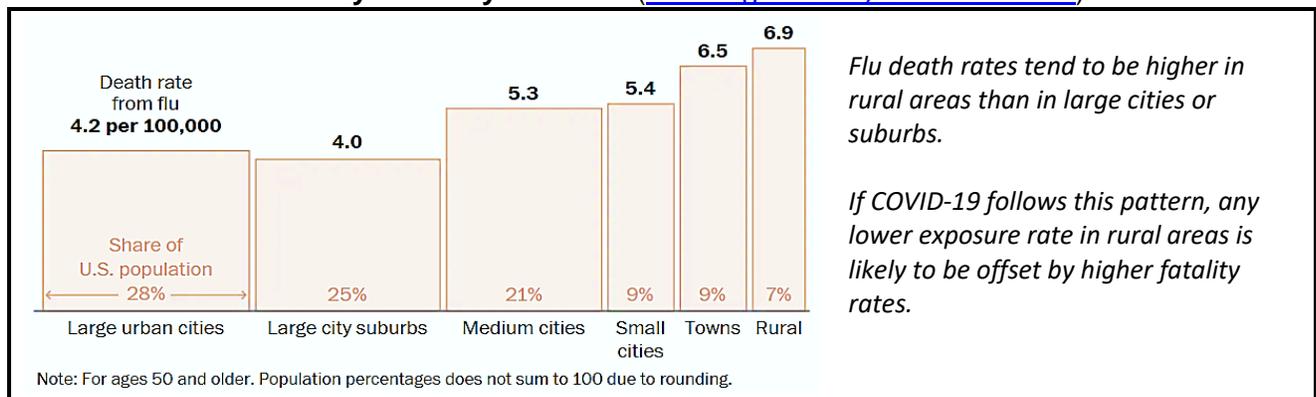
For this analysis, it is also important to measure risk *per capita*. Denser areas have more COVID cases but less dense areas tend to have higher infection and death rates. Although the pandemic took longer to reach rural areas, once established it had higher fatality rates due to higher-risk populations,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

Exhibit 6 Urban-Rural Covid Death Rates (CDC Data)



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)



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, there are other reasons to favor compact development.

Overall, urbanization tends to reduce most major causes of death (cardiovascular and respiratory diseases, cancers and unintentional injuries), and so increase 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)

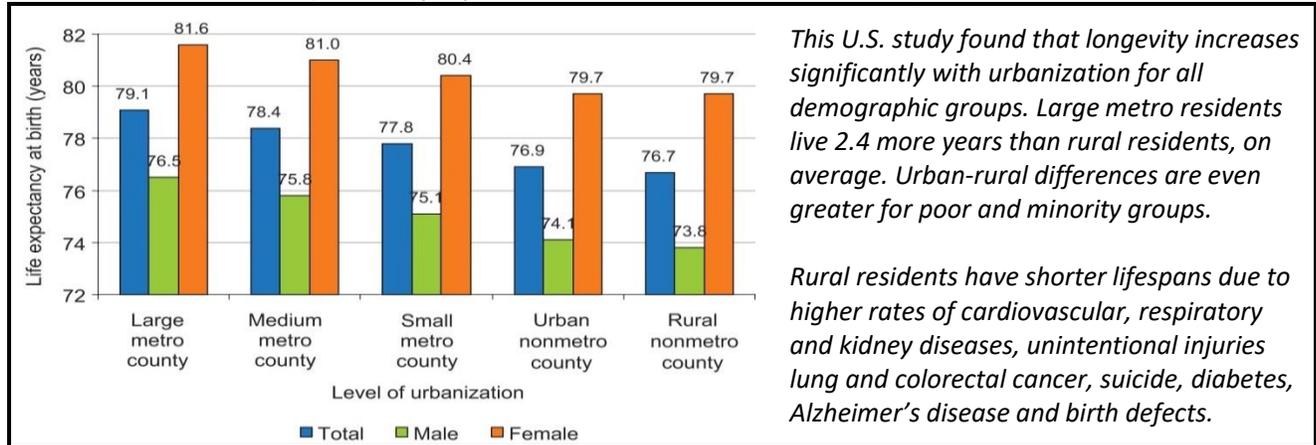


Exhibit 9 Age-Adjusted Death Rates, U.S., 1990–2009 (Singh and Siahpush 2014b)

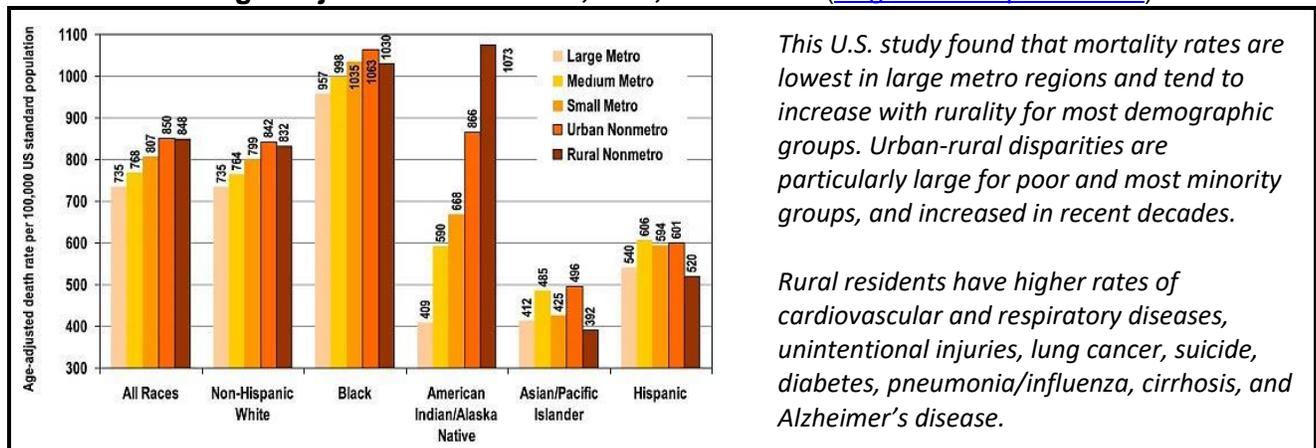
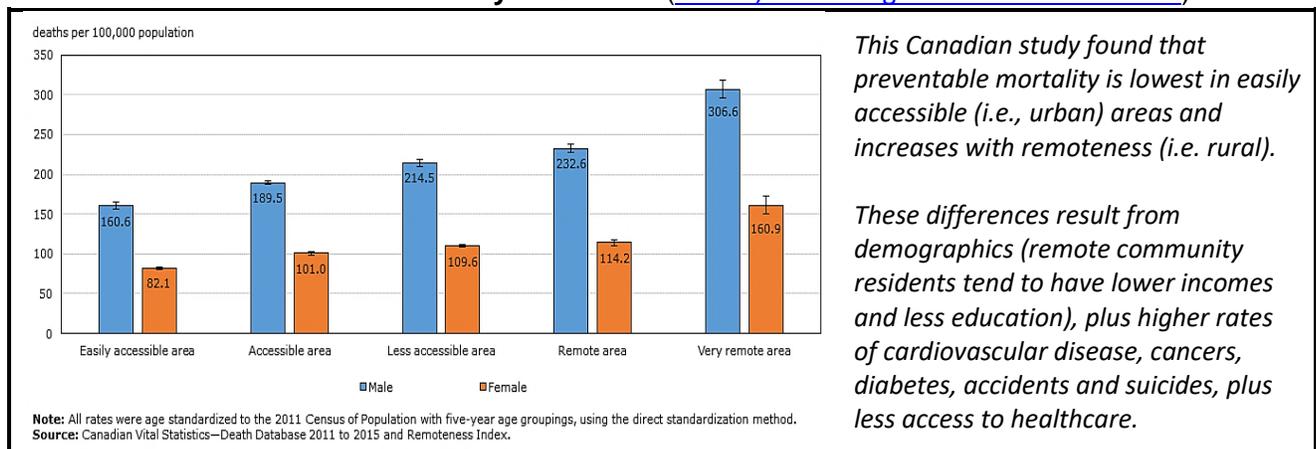


Exhibit 10 Preventable Mortality in Canada (Subedi, Greenberg and Roshanafshar 2019)



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	<ul style="list-style-type: none"> • Crowded buildings and sidewalks • Elevators • Public transit • Homelessness and inadequate housing 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Targeted cleaning • Promote hygiene • Promote physical distancing • Improve walking and bicycling • Eliminate homelessness and improve housing quality 	<ul style="list-style-type: none"> • 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.

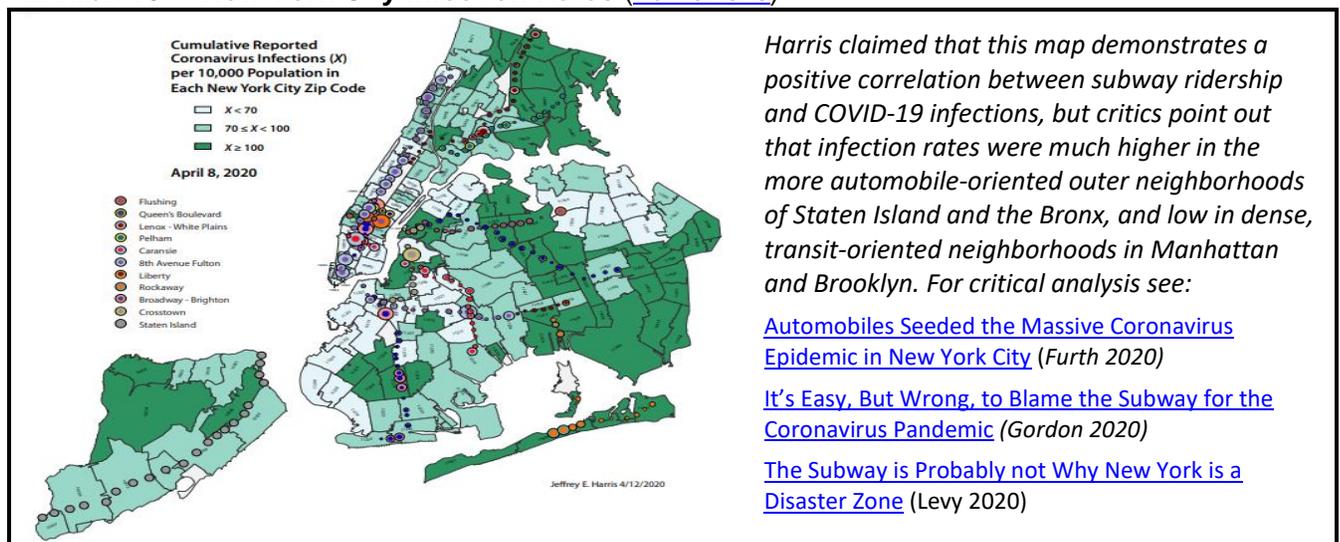
Transport Risks and Solutions

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 can 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 passengers in private automobiles, taxi and ridehailing, and public transport. This can severely constrain the out-of-home activities of non-drivers in automobile-dependent areas. Commuters who don't drive may be unable to work, and adolescents lack independence. 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 late-March 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](#)).

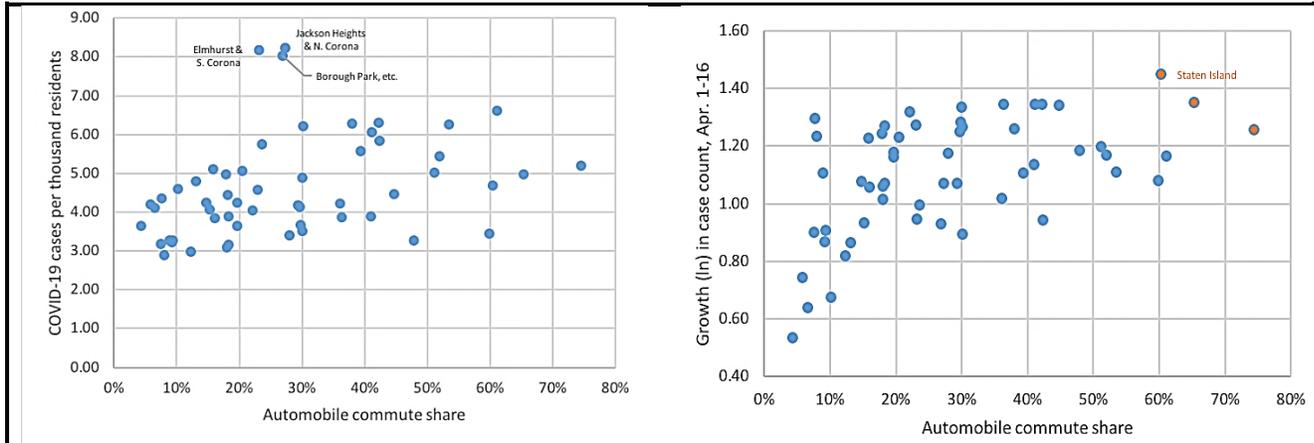
Exhibit 13 New York City Infection Rates ([Harris 2020](#))



Detailed analysis of New York COVID-19 infection patterns by [Yang, et al. \(2021\)](#) found that infection rates increased with public transit commute distance but not with commute mode share, 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. This explains the high infection rates in more automobile-oriented areas, as illustrated below.

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 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.

Here are some pandemic-related travel 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](#)).
- [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).
- The pandemic [increased bicycle travel](#), and may justify more long-term [bicycling improvements](#).
- 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](#)).
- Emergency, service, freight and delivery vehicles received more recognition.
- Public transit was considered dangerous, leading to ridership losses and disinvestments. Advocates can respond with scientific evidence ([Levy 2020](#); [Litman 2018](#); [TUMI 2020](#); [UITP 2020](#)).

Will this pandemic 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](#)).

Resources for Reducing Transportation Pandemic Risks

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

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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 16 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](#).

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NAEH (2020), [Coronavirus and Homelessness](#), National Alliance to End Homelessness.

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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 17 Safety and Affordability by Mode

Pandemic Safety →	Telework	Bicycling	Walking
	Single-Occupant Vehicle		
	Taxi/ Ridehailing	Transit bus	
	Auto with passenger	Subway	
	Aviation		
Increased affordability →			

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.

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 18 Pandemic Resilient Housing

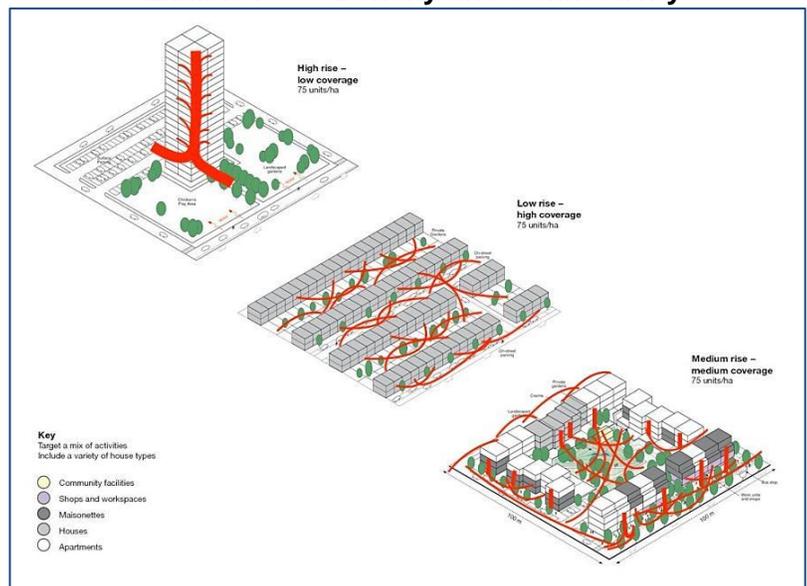


To reduce the isolation stress, homes need sufficient space and quiet, adequate light and ventilation, plus private outdoor areas such as a balcony or deck with seating, and, particularly for children, a yard or rooftop garden (Poon 2020; Zacka 2020). Home offices are desirable, particularly if household 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 where 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

Exhibit 19 Density and Connectivity



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 20 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 21 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 22 Resilience Planning Checklists

	Households	Communities
Reduces Pandemic Risks	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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.

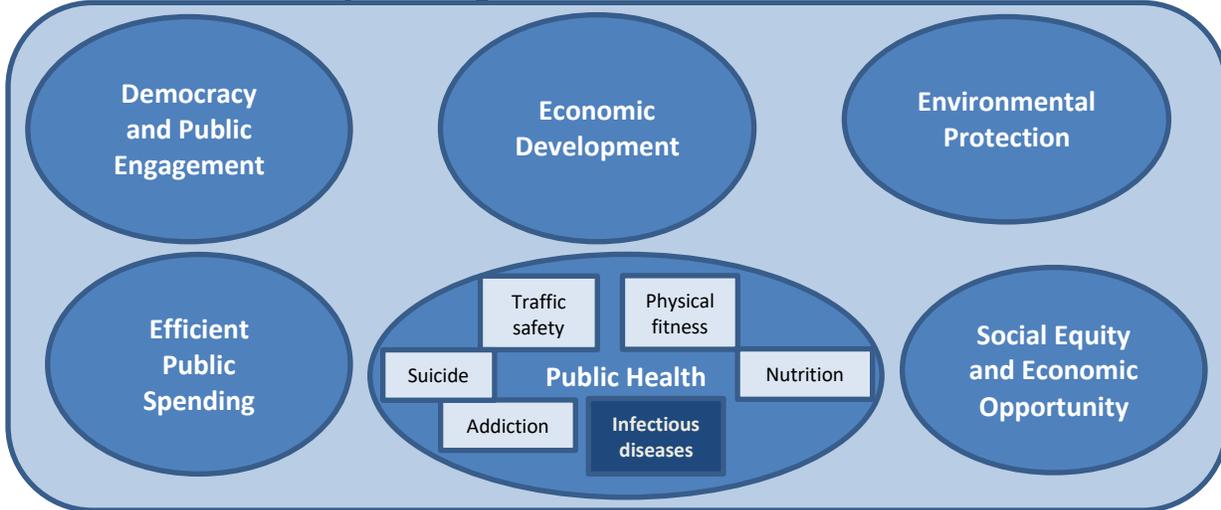
Good planning by households and communities can increase their resilience to pandemics and other risks.

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 flues are just one type of infectious diseases, infectious disease reduction is just one public health objective, and improving public health is just one community 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 to pandemic problems that also help achieve other community goals (Polis 2021; UN-Habitat 2021).

Exhibit 23 Community Planning Issues



Infectious diseases – including flu pandemics – are just one of many public health risks, and reducing these risks is just one of many community planning goals. Comprehensive planning strives to find win-win solutions that help achieve multiple community goals – such as solutions to pandemic problems that also support economic development, social equity and environmental protection.

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.

Exhibit 24 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 25 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.

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