Considerations for the Safe Lifting of Transit Capacity Restrictions out of Operational Necessity in the Times of the 2020 COVID-19 Pandemic

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Executive Summary

This paper outlines the research that shows that transit is a safe option for the public when transit agencies incorporate mitigation efforts and develop capacity restrictions that follow the CDPHE's COVID-19 dial dashboard. Based on evidence stated included, this paper supports the argument that transit is not a particularly dangerous space, and that lifting capacity restrictions (in the event that this becomes an operational necessity) can be evaluated on a case-by-case basis without the undertaking of undue risk. CDPHE has begun using a "COVID-19 dial dashboard" to delineate the differing degrees of COVID-19's severity. There are five color-coded levels: Protect Our Neighbors – green (least severe), Safer Level 1 – blue, Safer Level 2 – yellow, Safer level 3 – orange, Stay At Home – red (most severe). This paper encourages the collaborative development of policy (pertaining to transit operations) between public health entities and transit agencies, and that this policy be rooted in a community's unique set of needs, mitigation strategy performance, and local COVID-19 data. This paper also recommends that public health entities and transit agencies develop a set of capacity rules that correspond to each of CDPHE's five different degrees of COVID-19 severity.

On March 11, 2020, COVID-19 was declared a global pandemic. Following this declaration came a series of public health orders that set rules, guidance, and recommendations for individuals and physical spaces in an effort to curb rates of COVID-19 transmission. Shortly thereafter, Governor Jared Polis enacted a Stay-at-Home order requiring the closure of all non-essential businesses. Public transit in Colorado was deemed essential, and its operation was permitted to continue as long as it did so in accordance with latest public health guidance, including the CDC's social distancing definition of 6-feet.

This was not initially problematic for Colorado's transit agencies as rider demand remained low. However, at the time of this report we're seeing increasing ridership on many of Colorado's transit systems in both urban and rural parts of the state. Rural transit agencies associated with resort communities typically experience peak ridership during the ski season, and as it approaches there are concerns that limited transit capacity (due to 6-foot social distancing guidance) will quickly become overwhelmed with service providers unable to keep pace with demand, leading to a myriad of impacts including (but not limited to) the following: disproportionate consequences for transit-dependent riders of lower socioeconomic status; acute parking, congestion, mobility and air quality impacts for transit-oriented communities; existential threats to transit's performance and financial sustainability as service cuts and low ridership both disincentivize future usage and justify reallocation of municipal funding; potential for contentious situations and violence which drivers are unequipped to handle; and poor guest experience that repels tourists whom sales-tax funded communities are reliant upon.

The science surrounding COVID-19 transmission and suggested mitigation continues to evolve, although the most contemporary accepted research suggests that COVID-19 spreads primarily through respiratory droplets and aerosols, and can additionally spread through fomites (surfaces/materials that may contain the virus). In response to this, the staunchest mitigation guidance currently focuses on preventing the expulsion of respiration droplets through source control such as masks, the removal of viral aerosols through improved ventilation, and the neutralization of fomites through disinfection/sanitization. All of Colorado's transit agencies have enacted and documented their efforts to employ each of these modes of mitigation. Additionally, Colorado's agencies work routinely with the Colorado Association of Transit Agencies and the American Public Transportation Association to ensure the integration of the latest findings and emerging best practices.

While 6-feet social distancing is the standard benchmark used by the CDC; the WHO's guidance suggests 1-meter (around 3.3 feet) "when purchasing tickets, waiting to board, and moving around transport stations," their guidance however, falls short of reference to social distancing when actually riding transit. In settings with adequate source control and improved ventilation, it has been suggested that social distancing and

sanitization are less meaningful factors in relation to risk of transmission, especially when individuals are only together for a short period or time, and there is minimal talking or shouting, etc.

Internationally, there are many agencies operating outside of the CDC's 6-foot social distancing guidance – including Seoul, Tokyo, Singapore, and Milan (whose ridership have largely rebounded to pre-pandemic levels, despite no major escalation in cases. There are also several agencies in the United States and Canada that have lifted their capacity limits. Most notably, Boston's MBTA (which chose not to at any point implement social distancing requirements), NJ Transit, Calgary Transit, and Portland's TriMet. Neither Boston, Calgary, nor New Jersey have experienced a rise in cases; while Portland has seen an uptick that has been widely traced to living/care facilities, workplaces, schools, and childcare centers. Additionally, a French study found that of 150 case clusters, none were linked to transit. An Austrian study found that of 1,004 clusters, none were linked to transit; and a Swiss study found that of over 800 COVID-19 'hotspots,' none were linked to transit. In fact, a systematic review of available literature, studies, and their methodologies by the London School of Hygiene found the same thing: zero cases explicitly linking the transmission of COVID-19 to transit after the adoption of best practices.

Part 1: *Introduction*

Background:

Colorado reported its first two cases of COVID-19 on March 5, 2020. The first case, a man in his thirties, had recently traveled to Italy. The second case, an elderly woman, had returned from an international cruise. Following two weeks of escalation, Governor Polis Updated Public Health Order 20-22 on March 19, which closed "bars, restaurants, theaters, gymnasiums, casinos, nonessential personal services facilities, and horse track and off-track facilities statewide."[1] The next day, the Governor released Updated Public Health Order 20-23, which implemented social distancing measures.[2] As stated in the order, "The Centers for Disease Control and Prevention (CDC) in the United States Department of Health and Human Services (HHS) has recommended community mitigation strategies such as social distancing measures in order to protect the public's health." In addition to recommending social distancing (which the CDC defines as "at least 6 feet or about 2 arms' length"), PHO 20-23 required that no gatherings of more than 10 people be permitted.

Six days later, on March 25, Governor Polis issued an Executive Order requiring that "Coloradans Stay at Home," and on April 9, Governor Polis released Updated Public Health Order 20-24 Implementing Stay at Home Requirements.[3] From the earliest orders, public transit was immediately deemed an essential service and excepted from closure. Social distancing standards were applied de facto, and a sharp decline in demand and ridership translated into ample space for social distancing – the 6 feet, per CDC definitions. At the same time, the CDC was actively discouraging the wearing of masks,[4] agencies were struggling to find hand sanitizer and PPE, and COVID-19 testing and tracing was extremely limited.

Social distancing of 6 feet has not yet been a problem for most of Colorado's transit agencies, and overall demand continues to remain comparably low. However, many agencies anticipate a winter season surge that will quickly outpace their systems' capacity, assuming explicit 6-foot social distancing requirements remain in place. Peak ridership for Colorado's highest volume rural transit systems coincide with the state's coldest months, as these systems are located predominantly in mountain communities that serve nearby ski areas. During the winter, these communities experience a significant degree of tourists and seasonal workers, many of whom depend on public transit as their primary mode of mobility. Additionally, the built environment of these communities' downtown cores, ski resorts, worker housing, and especially parking facilities is often designed in a way that relies heavily on the transit systems. While other systems in the state are experiencing a steady increase in ridership resulting in more and more "overflow" riders, or riders left at stops due to bus capacity.

We are still in the midst of a global pandemic, and riding transit, buying groceries, returning to the office, sending your children to school, or jogging on a trail all come with inherent risks. Throughout this paper, the argument will be made that public transit is no less safe than any other space. Assuming the parties involved employ COVID-19 best practices as they relate to ventilation improvements, masking policy, and the disinfection of surfaces, a significant degree of empirical evidence dictates that a lifting of strict capacity restrictions can be done without the undertaking of undue risk. The following paper will examine factors relating to the following: Impacts of capacity restrictions, transit's quick stigmatization, the mechanics behind COVID-19's transmission, the mitigation efforts that are being undertaken, and the statistical relationship between transit performance and COVID-19 clusters, particularly in places without 6 foot social distancing policies.

Paper Purpose and Specific Recommendation:

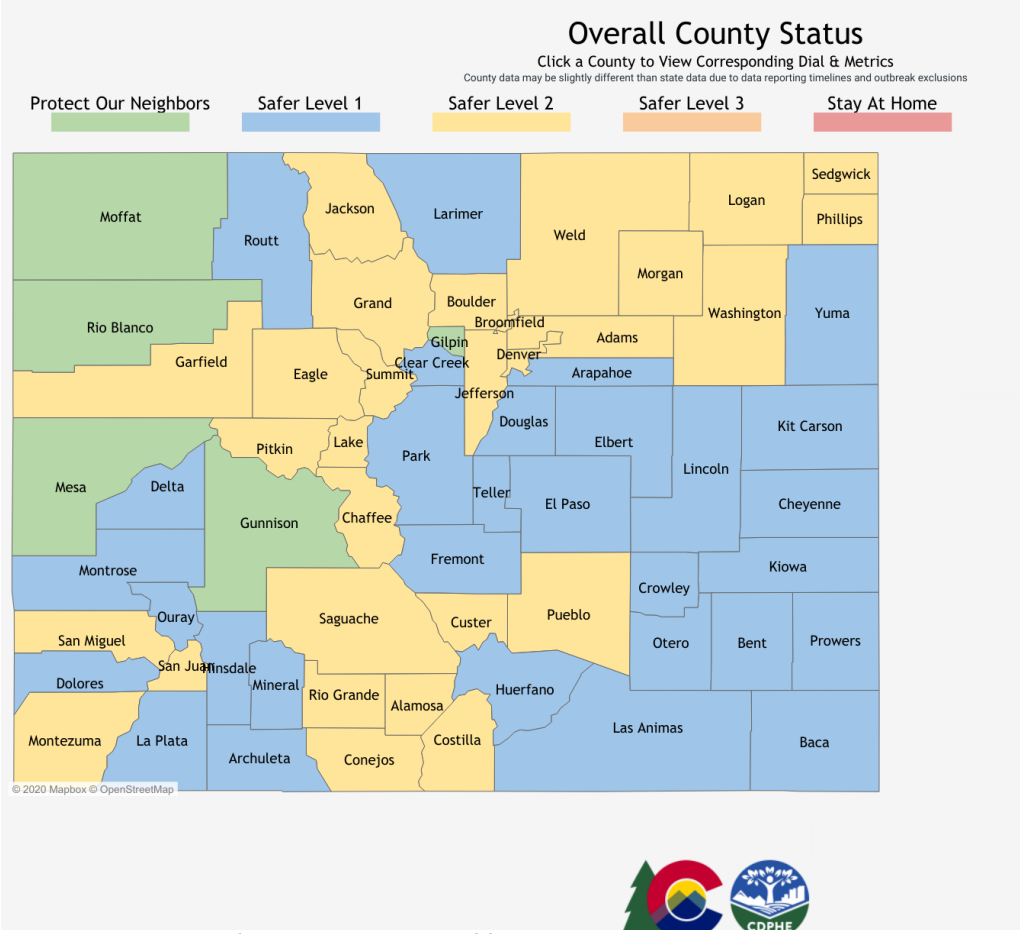
To the knowledge of the Colorado Association of Transit Agencies and its members, governance and rulemaking relating to the operation of public transit in the times of the COVID-19 pandemic goes as follows in most cases: CDPHE is utilizing guidance (rather than *binding regulation*) published by the CDC to dictate general state rules. Individual county public health entities are using the CDC and state guidance to develop their own policies, which public transit agencies within their county jurisdiction are required to comply with.

This paper is a tool to be used by Colorado's individual public transit agencies in conjunction with their respective county's public health entity to further develop policy relating to transit in the times of the COVID-19 pandemic. Specifically, this paper is meant to be used in collaborative discussions surrounding the lifting of transit capacity restrictions, assuming this becomes an operational necessity due to growing ridership demands. This paper merely exists as a resource for agencies to use at their discretion, and the use of this paper as well as the request to lift capacity restrictions is not intended to be compulsory.

CDPHE has been using a "COVID-19 dial dashboard" to delineate the differing degrees of COVID-19's severity. There are five color-coded levels: Protect Our Neighbors – green (least severe), Safer Level 1 – blue, Safer Level 2 – yellow, Safer level 3 – orange, Stay At Home – red (most severe). A potential "specific ask" of public health entities by the transit agencies within their jurisdiction is the development of a unique set of capacity rules that correspond to each of the five different degrees of COVID-19 severity. The justification for this is that demand is also expected to fluctuate depending on which color-coded level is designated.

	Colorado COVID Dial Level				
Trip Length	Green (least severe)	Blue (Safer Level 1)	Yellow (Safer Level 2)	Orange (Safer Level 3)	Red (Most Severe)
Less than 15 minutes	no capacity limit (standees allowed)	100% of seated capacity	75% of seated capacity	50% of seated capacity	25% of seated capacity
15 minutes or more	100% of seated capacity	75% of seated capacity	50% of seated capacity	25% of seated capacity	15% of seated capacity

Proposed Guidance for Transit: Prepared by CASTA



COVID-19 Severity by County: Prepared by CDPHE

Colorado Agency Impacts:

This section will provide specific examples from three of Colorado's highest volume rural transit systems. An inability to provide enough capacity to meet rider demand comes with a myriad of both acute and long-term concerns. Colorado communities exist with a diverse set of needs. While many agencies share the same concerns, each community is unique. That is why CASTA, on behalf of its members, is supporting an overarching policy that encourages transit agencies to work with their public health entities in the discussion of specific impacts and risks in order to move towards the development of mutually beneficial policy. Some of these risks are as follows:

- Inability to meet demand and provide adequate degree of mobility
- Disproportionate impacts for those of lower socioeconomic status/inability to provide trips for transit-dependent riders
- Acute parking challenges
- Congestion and air quality impacts
- Existential threat to transit's performance and financial sustainability as service cuts and low ridership can both disincentivize future usage and justify reallocation of funding
- Riders being left in cold conditions for too long
- Poor experience for tourists whom towns depend upon
- Potential for contentious situations and violence

Steamboat Springs Transit:[5]

Steamboat Springs Transit typically carries over 1 million passengers per year. During the town's peak seasons, it has ridership of more than 6,000 riders on ten buses per day. Due to restrictions and service cuts, the system's current capacity is up to 45 riders per hour rather than their usual potential capacity of up to 600 riders per hour.

- General capacity concerns:

  Based on previous seasons' ridership numbers, every bus will be full.

- Disproportionate impact to transit-dependent populations and seasonal workers:

  Because of how bus routes are laid out (due to the location of vacation lodging and workforce housing in relation to both the town and the resort), there is genuine concern that buses will fill up quickly with recreational users at its first stops, leaving no space for transit-dependent or workforce riders. Because of historical demand, there is risk that this could happen throughout the entire course of a day. There is no opportunity to counter this through policy, as by law agencies cannot discriminate based on trip purpose.

- Parking and mobility:

  Transit is a mobility backbone in Steamboat, and many places are designed to be accessed primarily by transit. If transit isn't utilized to its fullest, there will be acute parking challenges both in town and at resort facilities.

- Safety and security:

  When faced with a full bus (or several full buses in a row), there have been reports of verbal assaults and rising tensions. While Steamboat has only had minor issues so far, there is concern that this situation will escalate as winter approaches. Bus drivers do not have the tools nor training to diffuse potential physical confrontations as this is not meant to be part of their job.

- Financial sustainability:

  Throughout the pandemic, transit funding has been significantly reduced and reallocated towards other departments. If transit use is disincentivized due to service cuts and an inability to meet demands (because of capacity restrictions), this has the potential to translate into further justification for town administrations to begin reinvesting their transit funding in other ways. There is widespread belief that this is a tangible existential threat.

Gunnison Valley RTA:[6]

During the winter season, Gunnison Valley RTA operates 28 round trips a day on 57-seat, MCI D4500 over-the-road coaches. This past summer, the Gunnison Valley experienced what may have been its highest volume tourist season on record, leading many to project that this winter's tourist numbers will be no less than typical years past.

- General capacity concerns:

  Average winter peak time load factor is 77% or 44 passengers. This is nearly double the current 42% capacity cap of 24 passengers, meaning that if left unchanged, a significant portion of riders will be left behind.

- Disproportionate impact to transit-dependent populations and seasonal workers:

  Roughly half of Gunnison Valley RTA's riders are 'choice' riders while the other half are transit-dependent. According to surveying, 63% of winter riders are using the bus to commute to/from work, and only 54% of RTA passengers have their own personal vehicle.

- Parking and mobility

  A significant portion of commuters utilize transit as their primary mode to get to their jobs in Crested Butte or Mt. Crested Butte. A shift towards reliance on personal vehicles would cause serious parking challenges at both the resort and in the towns.

Breck Free Ride[7]

The Breck Free Ride shuttles passengers between satellite parking lots, resort facilities, and in and around Breckenridge – one of the world's busiest mountain resort towns.

- General capacity concerns:

  Expected ridership will outpace current capacity.

  - Parking and mobility:

    The Town of Breckenridge and Breckenridge Ski Resort are both designed to rely heavily on transit. If transit cannot be utilized to its fullest extent, there will parking challenges, especially as the town undergoes a construction project which will result in the temporary net loss of 550 spaces. Parking is a perennial issue that is widely discussed.

  - Congestion challenges

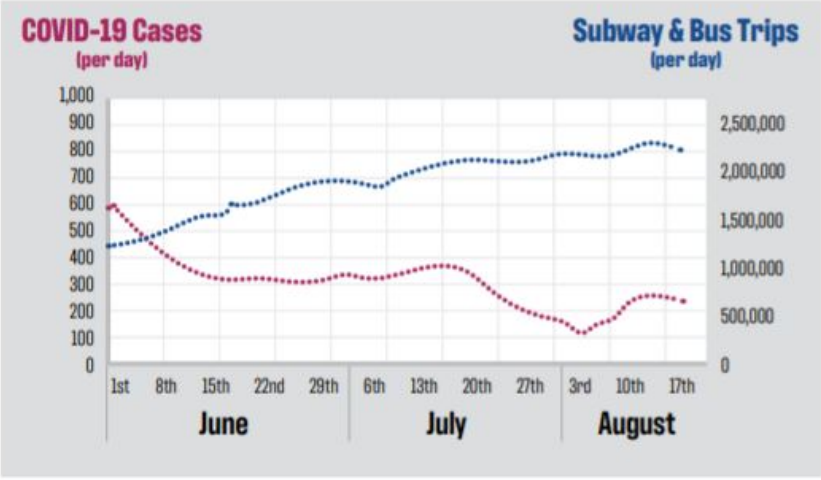
    While most guests do travel to Breckenridge via personal car, once they arrive they are most often able to leave it parked at their lodging location for the duration of their trip. A change in the service frequency or transit-centric culture could result in guests utilizing their cars to make short trips into town – resulting in the potential for major congestion related issues.

Part 2: *Transit's Stigma*

On April 24, MIT economist Jeffrey E. Harris released a now polarizing paper for the National Bureau of Economic Research titled *Subways Seeded the Massive Coronavirus Epidemic in New York*.[8] The paper argued that the "subway was a major disseminator – if not the principal transmission vehicle of coronavirus infection during the initial takeoff of the epidemic." Shortly after it was published, New York City Council Member Robert Holden cited Harris' paper in a letter sent from his office to Governor Andrew Cuomo, calling for the city to shut down its transit system as a mode of battling COVID-19. The letter was signed in conjunction with New York City Council Members Eric Ulrich, Peter Koo, and Mark Gjonaj.[9] To our knowledge, this paper was the first release of an academic or scientific source that explicitly linked the spread of COVID-19 to public transportation. Its findings were picked up by local and national news and circulated on social media, resulting in a global discourse surrounding local transit's role in the acceleration of a global pandemic through dense urban areas.

The paper gained immediate validity in certain circles as its assertions aligned with inherent public fears and perceptions of transit's dangers.[10] However, it was not peer-viewed nor published, and the work was met just as quickly with widespread criticism from mathematicians, epidemiologists, public health experts and transit policy experts. Emeritus fellow and viral disease transmission researcher with RTI International Philip Cooley noted that Harris' paper makes no effort to disentangle the many confounding factors that could easily make the subway not the primary vector," and a panel of disease modeling experts concluded for CityLab that the data visualizations that the paper presents do not clearly support the correlation that is being drawn.[11] Major publications such as *The Atlantic*, *Bloomberg*, *Vice*, and *The Wall Street Journal* have all since released articles with researchers rebuking the paper's methodology and claims. Abbey Collins, Chief Communications Officer for the New York MTA, called the paper "flawed – period."[12]

Despite the strength of responses by transit's wealth of supporters, the damage had been done. The initial fear of transit that the public had, following the validation of that fear in Harris' paper – perpetuated the ideas that



Data source: MTA, New York City Department of Health; Daily numbers represent 7-day rolling averages.

during the pandemic, public transit is a space less safe than others, and therefore a meaningful driver of the virus' spread. Transit was deemed a *greater* danger until proved otherwise.

Of this perception, Mohamed Mezghani, the Secretary General of the International Association of Public Transport said, "We have to accept it, people will have this perception that you can get the virus in public transport."[13] When the New York Stock Exchange floor partially reopened on May 26, it barred the entering of people who arrived using public transit,[14] and the CDC *Employer Information for Office Buildings* webpage is still, as of September 11, asking employers to urge their employees to avoid commutes via public transportation.[15]

Part 3: *COVID-19's Spread and Mitigation*

How Does COVID-19 Spread?

While the study of COVID-19 continues to evolve, it is indisputable that more is now known than when initial public health guidelines were published (and when riding transit was first stigmatized as a particularly risky activity), 7 months earlier. As of the time of this paper's writing, there is the accepted consensus among global health entities that transmission of COVID-19 is thought to primarily occur person-to-person through three ways:[16]

- **Respiratory droplets –** Droplets that are expelled from the lungs of an individual when they speak, breath, or sneeze. Infection is spread by the inhalation of these droplets
- **Aerosols –** The tiny particles of the respiratory microdroplets that remain suspended in the air for minutes or potentially hours in poorly ventilated spaces. Infection is spread by the inhalation of these microdroplets
- **Fomites –** Surfaces and objects that are contaminated by the virus. Infection is spread when an individual touches a contaminated surface and then brings it in contact with their eyes, nose, or mouth

Respiratory microdroplets and aerosols are thought to be the primary ways in which COVID-19 is spread, while fomites are not thought to be as acute of a contributor to transmission. In addition, duration of exposure is known to be a factor relevant to transmission. While there is not yet sufficient data to know what exact duration increases risk; Dr. Erin Bromage of UMass Boston affirmed the now commonly cited adage, "Successful Infection = Exposure to Virus x Time,"[17] and the CDC defines the threshold of "prolonged exposure" to be 15 minutes of close contact.[18]

Mitigation Strategies

Understanding (what is currently known about) the mechanics and modes of COVID-19 transmission, means that as a result, there are adequate ways to design and implement mitigation strategies to counter its transmission. According to Xavier Querol of the Institute of Environmental Assessment and Water Research who led a series of related studies for the Spanish National Research Council, "with facemasks, ventilation, and disinfection – transit is no less safe than a café (or other outdoor spaces) where people talk without their masks on."[19]

A variety of transit agencies responded to CASTA' survey when asked what steps they were taking to mitigate risks during the pandemic. Transit agencies that participated include Bent County Transit, Mountain Metro Transit of Colorado Springs, City of Cripple Creek, City of Durango, ECO Transit, Gunnison Valley RTA, Pitkin County Transit, Roaring Fork Transportation Authority, Neighbor to Neighbor of Salida, San Luis Valley Transportation, Steamboat Springs Transit, and City of Telluride.

Some of the physical changes transit agencies around the state have made include:

- Installing a plastic barrier between the driver and passengers
- Installing sneeze guards between
- "Fogging" busses using an electrostatic sprayer every night

- Fitting busses with UV lights in the HVAC system
- Fitting busses with antimicrobial cloth in the HVAC filters
- Blocking off seats to force social distancing
- Sanitizing busses nightly
- Placing cleaning supplies on busses
- Suspending fares temporarily to avoid driver contact
- Cleaning fixed route busses during every layover
- Cleaning the passenger lobby every 30 minutes
- Installing hand sanitizer on busses and in passenger terminals
- Adding busses to routes to reduce the passenger load
- Wiping down ADA vehicles after every transport
- Providing gloves for drivers
- Providing reusable cloth masks for drivers
- Providing disposable masks for passengers

Some of the behavioral changes transit agencies around the state have made include:

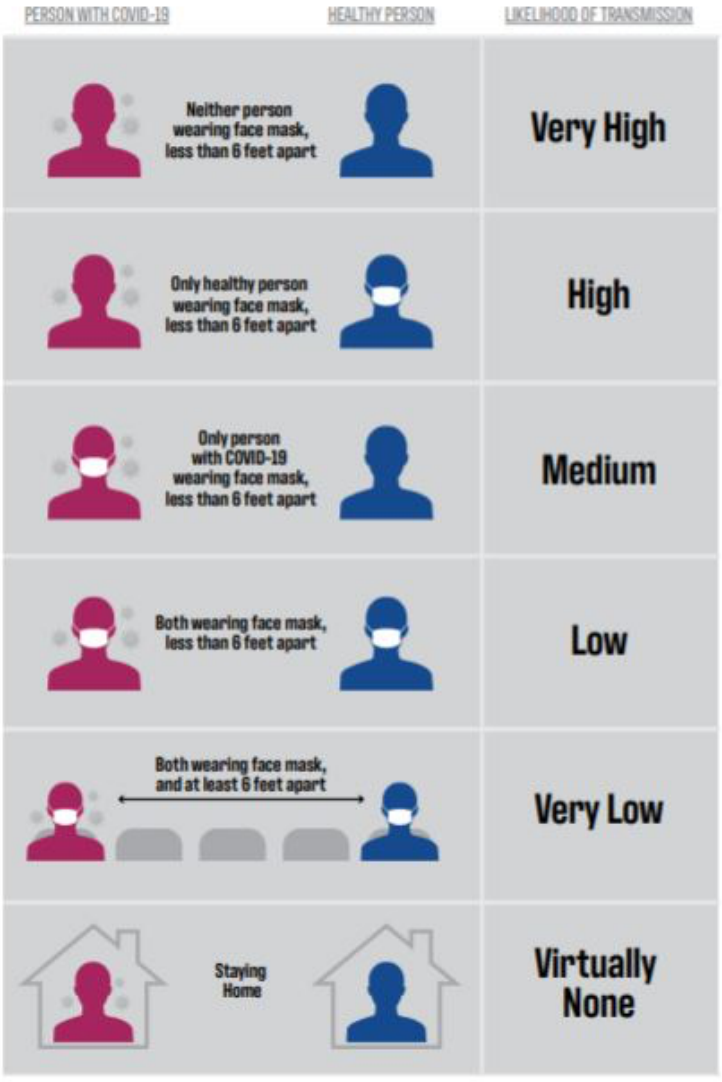
- Screening drivers' health daily
- Requiring drivers to fill out a health questionnaire prior to each shift
- Checking the temperatures of drivers
- Requiring mask use at all times for drivers and passengers
- Requiring drivers to leave immediately if they are feeling sick
- Maintaining a six foot distance amongst employees
- Prohibiting employees from gathering in offices and other communal work spaces
- Encouraging passengers to self screen for symptoms
- Prohibiting drivers from touching passengers or their luggage (with exceptions)
- Encouraging passengers to pay in advance through an app
- Prohibiting writing utensils
- Leaving windows open if the weather is acceptable
- Requiring 14 day quarantine if a staff member is exposed
- Limiting special needs busses to one rider at a time

Transmission Type	Mitigation Strategies
COMMUNITY SPREAD 	**Lowering overall infection rate in an area via elimination methods such as::** ☐ Robust testing and contact tracing ☐ Isolation protocols ☐ Mobility restrictions ☐ Restricted entry (thermal scanning, COVID-19 screening, etc.)
RESPIRATORY DROPLETS 	**Reducing risk of contact with and spread of respiratory droplets via methods such as:** ☐ Covering of nose and mouth with a face mask or shield ☐ Physical distancing ☐ Ventilation, filtration, and air flow controls
AEROSOL (DROPLET NUCLEI) 	**Reducing risk of contact with and spread of aerosols via methods such as:** ☐ Covering of nose and mouth with a face mask or, if available, respirators such as N95/KN95 masks ☐ Physical distancing ☐ Ventilation, filtration, and air flow controls ☐ Humidity controls
SURFACE (FOMITES) 	**Reducing the risk of contact with and spread of fomites via:** ☐ Covering of nose and mouth with a face mask or shield ☐ Cleaning and disinfection of surfaces ☐ Hand washing/sterilization

Modes of Mitigation: Prepared by APTA

Mask Wearing:

Researchers have long known that masks can prevent people from spreading airborne germs.[20] Per the WHO, all masks provide source control – or form an effective barrier that blocks respiratory droplets and aerosols from being expelled beyond a wearer's mask and into the air;[2] on the other hand, it was initially thought that only certain masks could prevent its wearers from inhaling aerosols and particles, there is now increasing evidence that even non-respirating masks – such as cotton masks – provide protection from the virus.[2] "Wearing a mask may be the one thing that can make the biggest difference in reducing the virus' spread," stated Dr. Larry J. Anderson in an interview for APTA who also added that as another utility, masks lessen the risk that wearers will auto-inoculate themselves – by touching their mouth or nose.



Mask Evidence:

- In one case study involving intercity bus transport, a symptomatic male passenger from Chongqing, China, rode a bus with 39 other passengers for approximately two hours and ten minutes while not wearing a mask. The passenger then purchased a mask before the second leg of his journey – a 50-

minute ride with 14 other passengers on a minibus. On the first bus he infected five people and on the second bus he infected zero.[1]

- Two infected hair stylists in Springfield, Missouri, saw 139 customers over the course of a week. During this time, both stylists and customers were required to wear masks. Zero clients reported symptoms though all were encouraged to get tested for COVID-19; of the 67 clients tested – all test results were negative.[21]

Ventilation Improvements:

In general, researchers have proven that adequate ventilation is helpful for reducing virus transmission.[22] Both the CDC and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommend increasing outdoor ventilation,[1] and it has been found that when a large amount of air is supplied to a space – it ensures dilution of airborne infections and makes their transmission less likely.[2] Typical city buses replace fresh air through their ventilation systems close to 18 times per hour, which is far more frequent than the 6 to 8 times per hour recommended for restaurants and the 5 to 6 times per hours recommended for classrooms.[2] [1]

Ventilation Evidence:

- In an outbreak in Guagzhou, China, poor ventilation and the recirculation of infected air is suspected to have contributed to the airborne transmission of COVID-19 to more than 50% of diners at an indoor restaurant.[i]
- On a 50-minutes bus ride in Hubei province, China, an infected passenger transmitted the virus to 24 out of 67 passengers. This was before the adoption of compulsory mask use, and the bus did not have a working ventilation system.[3] [2]
- A study of 2,300 infected passengers who traveled on trains in China between December and February found that of the 72,000 passengers who sat close, only 234 – or 0.33% contracted the disease. This was before the adoption of compulsory mask use, however the Chinese train systems are known to have superior ventilation and air filtration systems.[3]
- In one study tracing the source of outbreaks in Japan, transmission of COVID-19 was found to be 18.7 times more likely in an enclosed indoor setting without adequate ventilation, than in settings with either improved ventilation or some degree of outdoor airflow.[4]

Disinfection:

In addressing questions of how to slow COVID-19's spread, disinfection of surfaces in addition to a stressing of the importance of hand hygiene were among the very first recommendations that global health entities made; even predating the adoption of virtually-universal mask wearing and social distancing of 6-feet. An emphasis on disinfection and a provision of hand sanitizer to passengers (though availability was limited at the pandemic's earliest stages) were mitigation strategies that were very quickly adopted by transit agencies and their industry groups. While there is now a building consensus that COVID-19 transmission takes place person-to-person rather than person-to-surface,[3] the daily disinfection of surfaces is one of the most visible actions that can be done, and according to Dr. Robyn Gershon of NYU School of Public Health, "frequent cleaning helps increase public confidence in the transit system."[3]

Disinfection Evidence:

> In June, a team from the Spanish National Research Council analyzed samples taken from handrails, stairs, turnstiles, vending machines, and AC filters at the Valencia Metro (which disinfects daily). Of all samples analyzed, no COVID-19 was found on the premises.[3]

CDC Recommendations:

The main tenets of the CDC's guidance as of September 11, dictate that transit agencies clean and disinfect high touch surfaces daily, use methods or barriers to physically separate passengers or employees, provide access to soap and water or hand sanitizer with at least 60% alcohol, and take efforts to increase the circulation of outdoor air and improve ventilation through a variety of means including the installation of new devices and filters, and the use of natural ventilation by opening doors and/or windows.[3] It is also suggested that passengers and employees wear masks, practice hand hygiene, avoid touching surfaces, and practice social distancing in accordance with their definition of 6 feet.[23]

Colorado Transit's Response:

The transit industry (and Colorado agencies in particular) have been thorough and proactive in their COVID-19 response. On February 28, the Colorado Association of Transit Agencies (CASTA) sent out its first newsletter providing information about pandemic planning. The newsletter included an APTA webinar, the *Guide for Public Transportation Pandemic Planning and Response*, and current CDC fact sheets. That same week, CASTA created a webpage of COVID-19 resources and a list of companies that had PPE and cleaning supplies in stock. Starting at the beginning of March – CASTA, American Public Transportation Association (APTA), Community Transportation Association of America (CTAA), and the Federal Transit Authority (FTA) began collecting all available info and pushing it toward their transit agency grantees. At the time, best practices and procedures were changing daily and CASTA continued to send 2-3 newsletters per week – as emerging guidelines were coming out so quickly. In early April, CASTA wrote a letter to Colorado's Governor and US congressional delegation to affirm Colorado transit agencies' essential service role during the pandemic and the comprehensive efforts being undertaken to mitigate transmission risks. CASTA began convening weekly COVID-19 response meetings on April 21 and continues to host meetings and routinely disseminate emerging information.

Since the beginning of the pandemic declaration, CASTA has ensured that all of its member agencies remain highly engaged in the process of discussing, learning, and implementing best practices. While fleet, facilities, and services differ – all agencies have been extremely focused on emerging science, and have been inventorying their assets to develop mitigation strategies relating to each.

Examples of Colorado Agencies' Ventilation Improvements:

Steamboat Springs Transit[24]

Steamboat Springs Transit (SST) operates a split fleet; some of their vehicles have AC and some do not. For the vehicles without – SST is significantly improving natural ventilation by operating service with the windows and roof vents open. In addition, passengers load through rear doors while drivers keep the front door propped. These buses stop and open their doors approximately every 2 minutes, or more than 30 times an hour – allowing for the additional exchange of outdoor air.

Vehicles with AC utilize a hatch that brings in fresh air that runs through the buses' ventilation system. These buses require a closed environment for their ventilation systems to work properly, so they operate with windows and roof vents closed. Additionally, all air handling intake ports are sprayed with disinfectant as they collect air.

Gunnison Valley RTA[3]

Gunnison Valley RTA's buses have HVAC systems that replace the air in the bus with fresh air 7 times per hour. All air initially flows through a compartment with recently installed UVC light disinfection systems; the air then moves through a regular filter and an added antimicrobial filter before it goes back into the bus's main cabin

Breck Free Ride[3]

Some buses currently have fresh air intake and others do not. For buses with fresh air intake, interior air is replaced in about 90 seconds. Buses without this option are currently running with windows open – per current CDC guidelines. Breckenridge is in the process of installing fresh air intake on their entire fleet – a project which will be completed by the winter season.

Summary of Considerations:

Similar to debate over the importance of the disinfection of surfaces, there is emerging science that suggests that physical distancing may be less important in situations where individuals are masked, not talking, together for only a short period of time, and there is efficient ventilation.[3] Overwhelmingly, public transit – especially in Colorado, checks off all of these boxes.

Factors that may have the ability to prevent COVID-19 transmission:

- Improved ventilation and air flow
- Strict masking policy
- Short trip duration
- No or minimal talking or shouting

Social Distancing:

While there are on-going discussions relating to both the value and efficacy of social distancing, CDC guidelines and definitions (as mentioned) do *recommend* social distancing of 6-feet. Internationally, however, World Health Organization guidance dictates that passengers "keep a distance of 1-meter (roughly 3.3-feet) from others when purchasing tickets, waiting to board public transport, and moving around transport stations."[3] Their guidance stops short of mentioning social distancing while riding transit. European transit providers have broadly employed the WHO 1-meter standard and have encouraged their passengers to maintain their distance to whatever degree is possible while refraining from the mandate of specific requirements. A systematic review by the San Francisco Municipal Transportation Agency (SFMTA) in their August report on COVID-19 best practices found that the transit agencies serving Berlin, Paris, Lyon, London, and Vienna, did not require specific distance nor share customer-facing information regarding distancing policy.[2] In addition, while several public transit industry groups did encourage riders to keep distance from one another, all (reviewed by SFMTA) went out of their way to avoid the establishment of specific distances or capacity limits[25] – thus deferring to individual agencies and the entity responsible for public health in their jurisdiction to make those decisions at their discretion.

Part 4: *Transit and COVID-19 Transmission*

Contemporary CDC transit guidelines do not reflect the empirical evidence from the agencies around the globe that have successfully lifted (or chose not to enact) capacity restrictions, while experiencing no subsequent spike in cases nor clusters connected to transit.

Internationally, there are many agencies operating outside of the CDC's 6-foot social distancing guidance – including Seoul, Tokyo, Singapore, and Milan (whose ridership have largely rebounded to pre-pandemic levels, despite no major escalation in cases.[4] [5] [6] [7] There are also several agencies in the United States and Canada that have lifted their capacity limits too. Most notably, Boston's MBTA – one of the highest volume transit systems in the country – chose not to at any point implement social distancing requirements[2]. In addition, NJ Transit – serving all of northern and central New Jersey with an annual ridership of over 250 million,[2] lifted 50% capacity restrictions in mid-July per Gov. Phil Murphy's order.[2] Calgary – Canada's fourth largest city – removed their agency's capacity restrictions on August 17;[2] and TriMet – serving the Portland, Oregon region moved to 3-foot guidelines beginning on July 26.[2]

Neither Boston, Calgary, nor New Jersey have experienced a rise in cases; while Portland has seen an uptick that has been widely traced to living/care facilities, workplaces, schools, and childcare centers.[2] It is not just large agencies, however, that are evolving their policies. To employ a local case study of an entity that reflects the typical rural Colorado transit agency profile – ECO Transit in Eagle County began allowing drivers to load buses up to full seated capacity in mid-summer. They have worked closely with their public health department to monitor changes and trends. To date they have identified no cases of COVID transmission linked to a transit source. A study initially published on June 4, by the French, found that of Paris' 150 coronavirus case clusters that were recorded between early May and early June, none of them originated or spread meaningfully in the city's transit system. When updated on July 15, the study found that of the 386 clusters now recorded, there were 4, or just over 1%, that were centered around transit hubs; and following a larger nationwide study that identified 1,100 clusters from May through August, the rate of clusters connected to transit remained at around 1% or 15 total clusters. According to the same report, the largest share of infections – 27% – were linked to the workplace.[10]

A similar study published in July by the Austrian Agency for Health and Food Safety (AGES),[2] found that of 355 coronavirus case clusters, there were none linked to transit. When updated on September 11, Austria had experienced 1,004 clusters and 9,297 cases, and there were still none linked to transit. Of over 800 coronavirus 'hotspots' in Switzerland,[12] none were linked to transit; and a Japanese study of contagion clusters through the end of May [13] found that no clusters were linked to transit while most infections occurred in gyms, bars, concerts, and restaurants. At the time of publish for these studies – confirmed cumulative coronavirus cases for France, Austria, Switzerland, and Japan over the study's term, were 151 thousand, 31 thousand, 46 thousand, and 17 thousand, respectively.[16]

Though research is not yet comprehensive due to the comparably short duration of the pandemic thus far and the lack of intensive contact tracing through *many parts of the world*; in places where such tracing *was performed*, there were very few outbreaks linked to public transit and none following the widespread implementation of mask wearing procedures.[2] In fact, a systematic review of available literature, studies, and their methodologies by the London School of Hygiene found the same thing: zero cases explicitly linking the transmission of COVID-19 to transit after the adoption of best practices.[16] According to Dr. Thomas Matte, a Senior Science Advisor for Environmental Health at the global health organization, Vital Strategies, "the press coverage and public perceptions of COVID-19 transmission risk in transit has created more fear than is warranted by the evidence."[26]

Part 5: *Conclusion*

Scientific understanding and guidelines are changing daily throughout the course of the pandemic. COVID-19 was originally thought to be transmitted most acutely via contact with infected surfaces, creating an initial emphasis on the importance of sanitizing/disinfecting and discouraging masks. Guidance quickly shifted to require mask wearing as a mode of source control, as well as the promotion of ventilation improvements to maximize outdoor airflow. In the early weeks of October, the CDC confirmed for the first time that COVID-19 was airborne. Based on this and other commentary through this paper:

- Research shows that riding public transit presents a low risk
- Transit operators have shown a rapid and comprehensive response to evolving knowledge about COVID 19 and its transmission.

Few spaces are completely safe during a pandemic, and guidelines will continue to shift as more is learned. While global testing and contact tracing have not reached desired levels of comprehensiveness, there is still one piece of compelling evidence that suggests transit's relative safety when compared with other spaces. In situations where (a) transit agencies have adopted explicit masking policies and (b) have undergone ventilation improvements – there have been no identified COVID-19 outbreaks or clusters that have traced transit as the source. This is true in both cities where overall COVID-19 numbers continue to rise, and continue to decline.

Additionally, other modes of transportation, specifically airlines, are operating safely without mandating 6-foot social distancing or capacity restrictions. As illustrated through the latter sections of this paper, there is still no documented link between transit and COVID-19 cases in agencies that adhere to masking policies and improved ventilation.

There are many other spaces out there in the public realm that experience higher traffic, lower stigma, and a more reasonable perception of safety among the public. This paper argues that based on available data, transit's poor reputation in terms of safety is unfounded. Additionally, transit is an essential service that certain communities and segments of their population rely upon as their backbone; while this is dependent on the community, not being able to meet rider demand comes with a myriad of consequences that may pose significant threats.

This paper suggests that based on what is known, policies should exist flexibly at the community level; and that such policy should be built collaboratively by stakeholders, and most importantly – it should enable transit systems to rapidly respond to the unique needs of the community as well as the COVID-19 risk based on both macro data and that community's contemporary case volumes/transmission data, as well as their mitigation strategy and track record.

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