Public Transport COVID-19-Safe: New Barriers and Policies

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The COVID-19 emergency forced cities worldwide to adopt measures to restrict travel and implement new urban public transport solutions. The discontinuity and reduction of services made users recognize public transport systems as contamination vectors, and the decrease in the number of passengers can already be seen in several places. Countermeasures that reduce the contact with other passengers—directly (limit the number of passengers in vehicles) or indirectly (operate with large vehicles)—and increase offers are possible solutions to make users feel safe while riding.

Keywords: COVID-19 ; public transport ; hybrid discrete choice models ; infection prevention policies

1. The Roles of Urban Public Transport: From High Risk to Essential Service

Since the beginning of the COVID-19 crisis, public transport has been seen as an infectious disease vector.

The transmission can occur in two ways: (i) by inhalation and (ii) by contact [1]. These ways of infection bring pieces of evidence about the need for constant surface hygiene and ventilation. Inhalation is the primarily responsible type of contagious indoor infections [2]. The contact, on the other hand, can be direct or indirect. Direct contact is related to close contact and direct fluid exchange. Indirect contact infection occurs when a healthy individual touches the mouth, nose, or eyes after touching a contaminated surface touched and infected by sick individuals. Studies with other SARS-CoV family viruses demonstrated that the virus could persist on inanimate surfaces for nine days, depending on temperature and surface materials [3].

During the pandemic, a few solutions to identify ill individuals and prevent infection are proposed based on these symptoms such as the use of facial masks, trying to avoid droplets spread by cough, or fever screening. Screening is a solution used in different countries as a way to prevent disease spread. However, this is an “imperfect barrier to spread”, missing 50–75% of the infected cases [4]. During the incubation period, the symptoms cannot be detected, and some individuals might be asymptomatic [5]. The possibility of contaminated individuals being asymptomatic makes it challenging to recognize them and forces governments to promote preventive actions such as social distance or lockdown.

Experience with other respiratory viruses has shown that some infection clusters originated in transport systems [6][7]. This assumption is based on the fact that closed environments can increase the contamination value (R0), reaching a number close to 2.8 [8]. These values indicate that vehicles and terminal passenger transport stations can produce “overspread” events contaminating a large number of users. Other studies conducted in New York City (USA) and Wuhan (China) reported a high correlation between the rail system and new infections [9][10]. However, the studies missed some critical factors to attest cause–effect and did not significantly correlate to other PT modes. Therefore, there is still no evidence that PT is responsible for increasing infections, perhaps due to the rapid response of operators and governments to introduce countermeasures that prevent virus spread. However, it is true that the transport public system environment bunches a set of conditions that can favor the virus transmission.

PT vehicles (e.g., buses, trams, rails, and subways) usually are closed spaces with deficient ventilation [6]. System operators also admit, and expect, a high concentration of users during peak hours, where the recommended social distancing is not possible to maintain. The high number of passengers makes the control system more complicated, and there is a probability of not detected ill individuals being close to non-ill. Finally, users need to contact different surfaces that can be contaminated, such as handrails, turnstiles, and even ticket money [11].

In Latin American cities, the risk could be higher due to the long journey trips and the length of the exposure time window [6]. Long commuting is already associated with different health impacts, such as depression [12]. It is related to unequal patterns in access to jobs and public services, generating a substantial effect on the population travel pattern [13]. Groups with lower incomes are usually spatially segregated and limited regarding mobility and accessibility conditions [14]. Additionally, the PT service offered is unreliable, and transport costs substantially impact the family budget [15]. However, in some cases, public transportation is the main or the only option for vulnerable communities.

Since the mobility pattern and opportunity distributions are not equal in different populations, it is expected that lockdown measures would not have the same impact [16]. The equity implications are significantly higher for essential workers that do not have teleworking as an option. Many of these workers are in low-income groups (e.g., supermarket employees) and depend on public transit to keep working [10][17]. A study conducted in seven regions in Colombia reinforced these arguments [18]. The authors found a lower demand reduction in public transit than car trips, mainly because essential workers use PT to continue working.

Therefore, improving travel conditions on public transport is a matter of social equity and public health. Studying solutions to guarantee safe journeys and increase the perception of safety by users is essential. It is vital to organize robust emergency management programs to ensure that essential services keep working, and managing a resumption of economic activities is necessary for social well-being [19].

2. Making Transit Systems COVID-19-Safe

There is an effort to establish procedures that guarantee the safety of users and onboard crew in PT. Experiences worldwide have helped create a portfolio of countermeasures that focus on cleaning vehicles and stops/stations, mask use, and providing social distancing between users. There are examples of vehicle hygiene procedures in different parts of the world [20][21]. Pilots with ultraviolet light were conducted on buses and trains in New York City in an effort to make the transit system safer [22]. However, the effectiveness of this sanitized effort on vehicles is undermined. They also are human-resources-consuming and time-demanding [16][18].

Regarding vehicles, another vital measure is ventilation, which is particularly essential for an onboard crew that spends many hours a day inside the vehicles [11]. Ventilation can be a particular issue in metro systems, where natural ventilation is not possible. There are a few pieces of evidence of air conditioning spreading contaminated droplets [23], but no studies have been conducted so far on an inside vehicle environment.

Extensively used in some Asiatic cultures, the use of masks is passing through a popularization process during the COVID-19 pandemic. Studies show that face covers can be more effective in reducing virus spread than disinfection and frequent handwashing [24]. This measure relies on the user's response to a social appeal since they are responsible for having their own proper mask and wearing it correctly [6]. In different countries, their use became mandatory in closed spaces and public transit to guarantee users' protection.

Another essential countermeasure is the maintenance of social distancing. It is one of the solutions that have the most consensus in the scientific community. Studies show that a 1–2 m distance is enough to reduce virus transmission by droplets [25], and public transit operators are trying to adapt their vehicle layout to this parameter. For instance, this means that a standard-size 12 m bus will only be allowed to transport 18–20 users because the position of seated and standing passengers matters [26]. As a consequence of the capacity reduction, there are expected revenue impacts since it will be necessary to maintain a certain level of service to meet demand [27], and it might be unsustainable for massive systems. Despite the financial impact and the difficulty of inspecting, several Brazilian cities have adopted passenger capacity limits for bus transit systems [28][29][30][31].

There is still a group of measures that seek to avoid the demand for transport and thus guarantee a smaller number of passengers in the system. Some examples are actions that encourage telework, virtual meetings, and distance learning. The pandemic forced many companies to adopt this type of strategy during the lockdown. Experience in practice can help companies understand teleworking not as an emergency measure but as an opportunity to improve working conditions and reduce commuting [16]. Other actions, such as different work schedules, can also prevent crowding at the peak hour, spreading demand over the day and on different days of the week. Some Brazilian cities adopt staggered hours as a countermeasure and a peak spreading strategy. The city of Fortaleza identified a demand reduction of 26% in the morning peak and 19% in the afternoon peak. The city of Goiânia also found positive impacts: terminal overcrowding reduction and reduction in public transport complaints [32].

Finally, there are other types of countermeasures with a few pilot experiments in different cities. Pre-booked seating, temperature checks, only virtual payment, and better information to passengers regarding bus occupation and location are a few examples of other possible solutions to make public transit COVID-19-safe [11][26]. However, since all of these solutions impact operation and costs, it is essential to understand the user's safety perceptions and what would make them rely on PT when they need to use it.

3. User's Perception of Transport Quality and Transport Safety

In some cities, public transport usage was reduced by up to 90% during the pandemic [33]. Although part of this reduction is a consequence of social distancing and lockdown restrictions, the other part derives from the perception that public transportation is not safe [18]. Perceptions play a central role in travel attitudes. They help measure the individual's cognitive ability to represent and evaluate the levels of attributes of different alternatives. The choice process depends on how the levels of attributes are perceived by individual beliefs [34].

During the pandemic, the choice of using public transport is related to (i) the impossibility of traveling using other modes due to financial, social, or housing restrictions or (ii) the positive perception of quality and safety. Some authors believe that service quality results from comparing consumers' expectations with their perception of the actual service received [35]. However, there are often gaps between different perceptions of quality, and these gaps can be significant obstacles in trying to deliver a service that consumers perceive as a good service. Hence, it is crucial to implement measures that prioritize the quality and level of safety perceived by users [36].

Since COVID-19 is a new disease and information is continually changing over time, the users may have misperceptions about how safe it is to use PT. Therefore, communication plans are essential to provide information on how safe users are during the ride and promote safer behaviors [6].

References

1. Vijayalakshmi, S. Recent developments in corona virus disease-2019 (COVID-19). Res. J. Biotechnol. 2020, 15, 159–169.
2. Morawska, L.; Cao, J. Airborne transmission of SARS-CoV-2: The world should face the reality. Environ. Int. 2020, 139, 105730.
3. Kampf, G.; Todt, D.; Pfaender, S.; Steinmann, E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J. Hosp. Infect. 2020, 104, 246–251.
4. Gostic, K.M.; Gomez, A.C.R.; Mummah, R.O.; Kucharski, A.J.; Lloyd-Smith, J.O. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. ELife 2020, 9, e55570.
5. Mizumoto, K.; Kagaya, K.; Zarebski, A.; Chowell, G. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. Eurosurveillance 2020, 25, 1–5.
6. Pan, L.; Wang, X.; Zhao, K.; Ying, B.; Tang, S.; Zhang, J. Prevention and control of COVID-19 in public transportation: Experience from China. Environ. Pollut. 2020, 266, 115291.
7. Troko, J.; Myles, P.; Gibson, J.; Hashim, A.; Enstone, J.; Kingdon, S.; Packham, C.; Amin, S.; Hayward, A.; Van-Tam, J. NIs public transport a risk factor for acute respiratory infection? BMC Infect. Dis. 2011, 11, 2–7.
8. Liu, Y.; Gayle, A.A.; Wilder-Smith, A.; Rocklöv, J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J. Travel Med. 2020, 27, 1–4.
9. Harris, J.E. The Subways Seeded the Massive Coronavirus Epidemic in New York City; Working Paper 27021; National Bureau of Economic Research: Cambridge, MA, USA, 2020.
10. Zhao, F.; Gustafson, T.; Florida International University, M.; Federal Transit, A. Transportation Needs of Disadvantaged Populations: Where, When, and How? Federal Transit Administration: Washington, DC, USA, 2013; 91p.
11. Tirachini, A.; Cats, O. COVID-19 and public transportation: Current assessment, prospects, and research needs. J. Public Transp. 2020, 22, 1–34.
12. Wang, X.; Rodríguez, D.A.; Sarmiento, O.L.; Guaje, O. Commute patterns and depression: Evidence from eleven Latin American cities. J. Transp. Health 2019, 14, 100607.
13. CAF. Desarrollo Urbano y Movilidad en América Latina; Banco de Desarrollo de America Latina: Caracas, Venezuela; CAF: Dallas, TX, USA, 2011.
14. Guzman, L.A.; Oviedo, D. Accessibility, affordability and equity: Assessing 'pro-poor' public transport subsidies in Bogotá. Transp. Policy 2018, 68, 37–51.
15. Roberts, B.H. Managing Systems of Secondary Cities; Cities Alliance/UNOPS: Brussels, Belgium, 2014.
16. Mussel, C.; Avineri, E.; Susilo, Y. Editorial JTH 16–The Coronavirus Disease COVID-19 and implications for transport and health. J. Transp. Health 2020, 16, 100853.
17. Cash, R.; Patel, V. Has COVID-19 subverted global health? Lancet 2020, 395, 1687–1688.
18. Arellana, J.; Luis, M.; Cantillo, V. COVID-19 Outbreak in Colombia: An Analysis of Its Impacts on Transport COVID-19 Outbreak in Colombia: An Analysis of Its Impacts on Transport Systems. J. Adv. Transp. 2020, 2020, 16.
19. Fletcher, K.; Amarakoon, S.; Haskell, J.; Penn, P.; Wilmoth, M.; Matherly, D.; Langdon, N. A Guide for Public Transportation Pandemic Planning and Response, A Guide for Public Transportation Pandemic Planning and Response; The National Academies Press: Washington, DC, USA, 2014.
20. Australian Government. Principles for COVID-19 Public Transport Operations; Australian Government, Department of Health: Canberra, Australia, 2020.
21. UITP. Public Transport Authorities and COVID-19: Responses from the Front Line; Australia/New Zealand, International Association of Public Transport: Brussels, Belgium, 2020.
22. Romine, T.; Sgueglia, K. New York Transit Agency Launches UV Light Pilot Program in Effort to Kill COVID-19. CNN. 2020. Available online: https://edition.cnn.com/2020/05/20/us/new-york-transit-uv-light-trnd/index.html (accessed on 29 August 2020).

23. Lu, J.; Gu, J.; Li, K.; Xu, C.; Su, W.; Lai, Z.; Zhou, D.; Yu, C.; Xu, B.; Yang, Z. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020. Emerg. Infect. Dis. 2020, 26, 1628–1631.
24. Wang, J.; Pan, L.; Tang, S.; Ji, J.S.; Shi, X. Mask use during COVID-19: A risk adjusted strategy. Environ. Pollut. 2020, 266, 1–6.
25. Chu, D.K.; Akl, E.A.; Duda, S.; Solo, K.; Yaacoub, S.; Schünemann, H.J.; El-harakeh, A.; Bognanni, A.; Lotfi, T.; Loeb, M.; et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: A systematic review and meta-analysis. Lancet 2020, 395, 1973–1987.
26. Parashar, L. “Standard Operating Procedures (SOPs)” for Bus Transp. Post COVID-19 Lockdown; Integrated and Sustainable urban Transport Systems in Smart Cities: New Delhi, India, 2020; Available online: https://sutp.org/publications/standard-operating-procedures-sops-for-bus-transport-post-covid19-lockdown/ (accessed on 29 August 2020).
27. De Vos, J. The effect of COVID-19 and subsequent social distancing on travel behavior. Transp. Res. Interdiscip. Perspect. J. 2020, 5, 100121.
28. DOM—Diário Oficial do Município. Dispõe Sobre Medidas Voltadas à Prevenção da Disseminação da Epidemia de COVID-19 No Serviço Público de Transporte Coletivo de Passageiros por Ônibus do Município; Diário Oficial do Município: Belo Horizonte, Brazil, 2020.
29. DOM—Diário Oficial do Município. Dispões Sobre Medidas Restritivas Regionalizadas para o Enfrentamento da COVID-19; Diário Oficial do Estadodo Paraná: Curitiba, Brazil, 2020.
30. DOM—Diário Oficial do Município. Estabelece Medidas a Serem Adotadas pelo Transporte Coletivo Urbano e Metropolitano, Transporte Privado de Passageiros, Transporte Individual Público e Privado, Para Enfrentamento da Emergência de Saúde Pública de Importância Internacional Decorrente do n; Diário Oficial do Município: Porto Alegre, Brazil, 2020.
31. DOM—Diário Oficial do Município. Reconhece a Situação de Emergência na Saúde Pública do Estado do rio de Janeiro em Razão do Contágio e adota Medidas Enfrentamento da Propagação Decorrente do Novo Coronavírus (COVID-19); e dá Outras Providências; Diário Oficial do Estado: Rio de Janeiro, Brazil, 2020.
32. Cabral, H.; Petzhold, G. Cidades Fazem Escalonamento de Horários por mais Segurança nos Ônibus durante a Pandemia. WRI Braz. 2020. Available online: https://wribrasil.org.br/pt/blog/cidades-escalonamento-de-horarios-seguranca-onibus-pandemia-covid-19#:~:text=Cidades%20fazem%20escalonamento%20de%20hor%C3%A1rios%20por%20mais%20seguran%C3%A7a%20nos%20%C3%
por%20Henrique%20Cabral&text=A%20ado%C3%A7%C3%A3o%20do%20distanciamento%20social,frente%20do%20combate%20%C3
(accessed on 29 August 2020).
33. Dublin City Council. Enabling the City to Return to Work: Interim Mobility Intervention Programme for Dublin City; Dublin City Council: Dublin, Ireland, 2020.
34. Ben-Akiva, M.; McFadden, D.; Train, K.; Walker, J.; Bhat, C.; Bierlaire, M.; Bolduc, D.; Boersch-Supan, A.; Brownstone, D.; Bunch, D.S.; et al. Hybrid Choice Models: Progress and Challenges Massachusetts Institute of Technology. Mark. Lett. 2002, 13, 163–175.
35. Dell Olio, L.; Angel, I.; de Ona, J.; de Ona, R. Public Transportation Quality of Service: Factors, Models, and Applications; Elsevier: Amsterdam, The Netherlands, 2017.
36. Machado-León, J.L.; de Oña, R.; Baouni, T.; de Oña, J. Railway transit services in Algiers: Priority improvement actions based on users perceptions. Transp. Policy 2017, 53, 175–185.