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How Might Adjustments to Public Transit Operations Affect COVID-19 Transmission?

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Issue

During the COVID-19 pandemic, public transportation systems worldwide faced many challenges, including significant loss of ridership. Public agencies implemented various COVID-19-related policies to reduce transmission, such as reducing service frequency and network coverage of public transportation. Recent studies have examined the effectiveness of these policies but reach different conclusions due to varying assumptions about how passengers may react to service changes.

Some studies proposed optimizing public transit operation timetables, service frequency, and network coverage to reduce the risk of COVID-19 transmission while also maintaining and/or increasing the level of ridership. However, there is currently no method available to perform such optimization. In response to this informational gap, researchers at the University of California at Berkeley developed a framework[1] to assist public transportation agencies to determine a near-optimal system timetable design, and develop network reopening plans for public transit. The team evaluated different reopening policies using this framework and developed an optimized timetable for the Bay Area Rapid Transit system.

Key Research Findings

Closing down whole public transit systems may not reduce the risk of COVID-19 infection very much. Some systems were entirely shut down during the pandemic, like bus systems in Wuhan in 2020.[2] However, studies[3] have shown no evidence that public transportation closures had an additional effect on the number of cases when other physical distancing measures were put in place.

COVID-19 risk is sensitive to how passengers react to changes in service levels. Different models produce different results due to their assumption about how passengers will react to reduced service levels. If demand remains strong even after reducing service or on-board capacity, then passengers will simply crowd onto the nearest open lines or stations. For this reason, it is important for policy makers to study historical data and to use more advanced demand models to predict the possible impact of various health policies on system demand.

Cutting service could actually increase the risk of COVID-19 transmission. Some cities closed busy train or bus lines to control the spread of COVID-19 and save money. While a few studies[3] found that closing high-demand routes can be an effective way to reduce the risk of infection, these studies assumed that passenger demand would fall. However, this approach may not be effective if demand remains high. For example, passengers may choose to use the nearest alternative routes when a line or station is closed which will lead to higher levels of crowding on open platforms which could increase the risk of infection. It is better to keep all lines open while adjusting timetables and service frequencies instead of closing some lines or stations.

On-board passenger limits may help control the spread of COVID-19 but could also lead to more infections if capacity limits are set too low. While limiting the number of on-board passengers to comply with social distancing can lower risk of transmission, new cases will rise quickly if the maximum capacity is set too low resulting in large numbers of passengers waiting on crowded platforms for the next available train. Other studies[4] have likewise shown the risk of infection is actually higher when car capacity is low, compared to if the capacity is higher. However, one study[5] found that since ridership may decline as capacity is reduced, COVID-19 infections will decrease because some passengers will simply give up their trips.

More Information

This policy brief is drawn from the report "How to Evaluate and Minimize the Risk of COVID-19 Transmission within Public Transportation Systems" prepared by Yiduo Huang and Zuojun Max Shen with the University of California, Berkeley. More details of the model referenced in the report and this brief can be found at https://arxiv.org/abs/2109.03940. For more information about the findings presented in this brief, please contact Yiduo Huang at yiduo_huang@berkeley.edu.

[1]Huang, Y., Shen, Z. (2020) Optimizing Timetable and Network Reopen Plans for Public Transportation Networks during a COVID19-like Pandemic. Available at arXiv 2109.03940.

[2]Hubei People's Government (2020) Wuhan Bus will Provide Service to Returning Riders. Available at https://www.hubei.gov.cn/zhuanti/2020/gzxxgzbd/sz/202003/t20200315_2182086.shtml (in Chinese)

[3]See, for example, Islam, N., S. J. Sharp, G. Chowell, S. Shabnam, I. Kawachi, B. Lacey, J. M. Massaro, R. B. D'Agostino, Sr., and M. White. (2020) Physical distancing interventions and incidence of coronavirus disease 2019: natural experiment in 149 countries. BMJ, Vol. 370, , p. m2743.

[4]Kumar, P., Khani, A., Lind, E, Levin, J. (2021) Estimation and Mitigation of Epidemic Risk on a Public Transit Route using Automatic Passenger Count Data. Transportation Research Record: Journal of the Transportation Research Board. doi:10.1177/0361198120985133

[5]Mo B, Feng K, Shen Y, Tam C, Li D, Yin Y, Zhao J (2021) Modeling epidemic spreading through public transit using time-varying encounter network. Transportation Research Part C Emerging Technologies 122:102893. doi:10.1016/j.trc.2020.102893

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