

Exhibit D

Research Project Requirement Template

Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables

Recipient/Grant (Contract) Number: The University of Texas at Austin/Grant # 69A3552344815 and 69A3552348320

Center Name: Center for Understanding Future Travel Behavior and Demand (TBD)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Chandra Bhat

Project Partners: N/A

Research Project Funding: \$75,000 (Federal + non-Federal funding)

Project Start and End Date: 9/1/2023 - 5/31/2024

Project Description: In this research, we focus our investigation on the telemedicine adoption preferences of patients/consumers. Our comprehensive approach contributes to advancing the existing body of knowledge in five distinct ways. First, we use rigorous multivariate econometric models that accommodate multiple sociodemographic and built environment (BE) variables at once rather than simple bivariate correlations of determinant factors with telemedicine adoption. Second, the framework is structured to discern the shifts in the effects of the factors affecting telemedicine adoption between the before- and after-COVID periods. This helps gain a deeper understanding of how socioeconomic and BE variables influenced telemedicine adoption before the pandemic and how the willingness of different segments of society to engage in telemedicine shifted as a result of the pandemic. Third, proposed multivariate model system recognizes that unobserved individual factors (such as technology savviness) that elevate telemedicine adoption before the pandemic may also affect adoption during the pandemic, and collectively influence an individual's intention to use telemedicine in the post-pandemic period. Not accounting for such intra-individual correlation effects due to unobserved individual-level factors variables will, in general, provide biased estimates of the evolution pattern of telemedicine adoption over time. In our study, the longitudinal data comprises responses from the same individuals across three specific time periods, offering a unique advantage in quantifying the causal effect of the pandemic on telemedicine use. Fourth, our study explores the reasons for using or not using telemedicine in the after-COVID period from the patient's viewpoint. We conduct a consumer-focused analysis that provides unique insights into the motivations, preferences, and concerns of different patient segments regarding telemedicine. Specifically, in the after-COVID period, for telemedicine adopters, we jointly model the reasons for adoption using multivariate binary probit models. Similarly, in the after-COVID period, for non-adopters, we use multivariate binary probit models to jointly analyze cited reasons for not adopting telehealth. This can inform healthcare providers, policymakers, and other stakeholders seeking to sustain telemedicine adoption post-COVID. Fifth, our study is the first that we are aware of in the travel behavior literature that focuses on telemedicine adoption. Earlier studies related to virtual participations have investigated tele-adoption in the context of work, grocery shopping, and non-grocery shopping, but have not considered telemedicine adoption. However, telemedicine adoption can also have transportation ramifications, just as virtual participation in other types of activities can (including individuals potentially appropriating the freed-up time for pursuing other activities). In this regard, we hope that our study will open up additional research in studying the travel implications of tele-participation in medical-related activities. This should be of particular interest in the context of medical accessibility for the increasingly aging population of many countries, including the United States.

US DOT Priorities: “Data-Driven Insight” (DOT RD&T Plan, Page 58-59) is a key underlying theme in this study. Our primary objective is to harness longitudinal data collected post-pandemic to contribute valuable insights to the earlier investigations on telemedicine adoption in our pandemic-altered world. Through the exploration of such data and the application of advanced multivariate econometric models, we aim to accomplish the task of assessing, anticipating, and strategically planning for the changes that telemedicine adoption will bring to the transportation system.

From an Equity perspective (DOT RD&T Plan, Page 33-34), telemedicine can improve accessibility to health care for individuals without access to personal transportation. However, it is important to acknowledge that certain sociodemographic groups may encounter challenges in utilizing this technology. These challenges will be a focal point of our study, as we endeavor to address and understand the nuances surrounding equitable access to telemedicine and its implications.

The proposed work addresses several of the technology transfer (T2) and deployment goals within the RD&T Strategic Plan. As telemedicine visits have become increasingly popular, researchers need to be in tune with the potential community wide impacts of the effects, and make the public and other stakeholders aware of the associated implications on health infrastructure planning as well as land-use transportation planning. The goal of this project is to disseminate the impacts of telemedicine visits to the public and other stakeholders through open-sourced journal publications, think pieces, and presentations – “This research helps stakeholders make informed decisions about whether to adopt new technologies, policies, or practices” (Page 64), “Continually improve mechanisms to share promising research, outcomes of demonstration projects” (Page 67) - while also suggesting new research directions for better understanding the implications at hand – “Identify potential research and lab efforts ripe for demonstration” (Page 67).

Outputs: The research will provide guidelines to consider the impact of telemedicine adoption on the generation and spatial distribution of health-related trips. The proposed research study will result in a paper that will be submitted to a relevant journal. Also, the paper will be submitted and presented at relevant conferences and meetings. The dataset compiled for this project as well as detailed formulations of the analytic models used will also be appropriately documented and made available for public use. In particular, any challenges (and approaches to overcome those challenges) will be noted when estimating the proposed multivariate econometric model systems. Policy measures to improve health-related accessibility for all individuals, including sociodemographic population segments that may experience challenges in accessing and utilizing tele-medicine, will be clearly identified and documented.

Outcomes/Impacts: The multivariate modeling system adopted in this paper is expected to uncover the relationship between telemedicine adoption (and the reasons for adoption/non-adoption) and a host of individual-level/built environment variables, while also accommodating individual-level unobserved factors and the evolution of adoption trends through a comprehensive temporal perspective. In addition to investigating telemedicine adoption tendencies, our study also will provide insights into the underlying reasons for both adopting and not adopting telemedicine in the after-COVID period.

The results from the study can assist healthcare providers in optimizing their offerings to cater to patient preferences. Healthcare systems also can leverage telemedicine to improve access to care, especially in underserved rural areas. The study also can aid the telecommunication sector in strategically investing in broadband connectivity to support higher intensities of telemedicine adoption. Finally, from a land use-transportation planning perspective, our research will shed more light on how healthcare infrastructure investments and land-use planning need to evolve. Also, it will aid in adapting activity-based travel demand models to consider the shifts in medical trips.

Final Research Report: A URL link to the final report will be provided upon completion of the project.