CONVERGE COVID-19 Working Groups for Public Health and Social Sciences Research

Research Agenda-Setting Paper

This paper was written to help advance convergence-oriented research in the hazards and disaster field. It highlights areas where additional research could contribute new knowledge to the response to and recovery from the pandemic and other disasters yet to come. Questions about the research topics and ethical and methodological issues highlighted here should be directed to the authors who contributed to this paper.

Working Group Name:

Social Vulnerability, Mobility, and COVID-19 Spatial Mortality Patterns

Working Group Description:

This Working Group aims to observe the spatial variation of the COVID-19 mortality rate with various sociodemographic and spatial variables such as social vulnerability, urbanization rate, health care accessibility, and living habits. This science-driven project integrates advanced computing environment, Geographic Information System (GIS), and novel AI algorithms to analyze spatial COVID-19 mortality patterns. We assembled an interdisciplinary team encompassing several sciences, including: GIScience, transportation science, social science, and epidemiology. This interdisciplinary framework seeks to provide spatial decision support for the government organizations to allocate health care supplies and advance welfare programs for vulnerable communities impacted by the pandemic. The research group partners with the Texas A&M Hazard Reduction & Recovery Center (HRRC) and Texas Target Communities (TTC), which involve a network of faculty members, university students, and local communities to fight against the COVID-19 pandemic.

Priority Research Topics and Specific Research Questions:

Priority Research Topics	Potential Research Questions
1. Uncovering the relationship between social vulnerability with COVID-19 infection, mortality, and impact of social distancing	• What are the leading social factors that have an effect on COVID-19 death in different geographic and socioeconomic regions? • How well do current social vulnerability indicators predict COVID-19 infection and mortality rates? • How do different social groups react to social distancing rules? • How efficiently are current health care supplies and welfare programs being provided based on the different socioeconomic regions and groups being served by the programs?
2. Integrating GeoAI in predicting COVID-19 infection and mortality pattern	• Can population flow data and other sociodemographic and built environment data be integrated into the GeoAI models to draw spatiotemporal dependencies hidden in the reported cases and associated factors to predict the disease spread pattern at a fine spatiotemporal scale? • Can the outcome from the GeoAI models be compared with officially reported cases,

	especially socially vulnerable communities where predicated cases might be much larger than confirmed cases, indicating possible under-reported issues? • Can GeoAI be combined with a survey to empower the mixed method approach on revealing how individuals and location matter at the fine scale in this event? • Can GeoAI predict the emergence of mortality? • How can GeoAI algorithms advance the understanding of mortality patterns by linking to conventional spatial epidemiological models?
3. Understanding mobility-related factors in causing Covid-19 mortality in socially vulnerable communities	• Can we predict the trend of mortality rate at a spatiotemporal scale based on mobility and social media data? • How does health care accessibility influence differential mortality rates? • What is the effect of mobility options, informal and formal, among socially vulnerable populations' mortality rates?
4. Identify the role of spatial decision support systems in reducing the COVID-19 mortality rate	• What are the different levels (i.e., individual, household, organization, government) of spatial decision problems in COVID-19 related mortality? • Where are the spatial mismatch locations between medical facilities and socially vulnerable communities' needs? • How relevant and efficient will the support system be for groups globally to mobilize aid efforts and work collaboratively with different needs? • Identify the strengths, fallbacks, and effectiveness of decision support systems in socially segregated and socioeconomically vulnerable communities.
5. Research challenges of using multi-source data fusion in modeling COVID-19 mortality risk	• What datasets are available for analyzing the mortality pattern of COVID-19? • What are the fallbacks of data fusion and sharing (e.g., multi-scales, spatial uncertainty, privacy concerns)? • How unbiased, relevant, and accurate the data being mined is to aid in spatial decision support systems?

Ethical / Methodological Considerations:

Data on COVID-19 requires access to health data that usually falls under protected health information under strict regulations. The ability to real-time track and support decision-making around the pandemic raises ethical concerns about access and sharing of this sensitive health data. Further, data on mobility raises ethical considerations and voluntariness of research participation by those who use devices or can otherwise contribute their location and movement without conducting primary data collection via surveys or interviews. Finally, data integration and data sharing are central to effective decision-support systems. But privacy, data ownership, and data sharing are central ethical questions for individuals and organizations. Finding ways to maintain privacy of data while integrating and conducting analyses is a research challenge.

Other Frameworks, Considerations for Collaboration, and/or Resources:

The research group has collected COVID-19 social vulnerability data at the Census tract level for major cities of the U.S. Additionally, the group has collected health care accessibility data, GPS mobility data, social media data, and mortality data. The research group partners with Texas A&M Hazard Reduction & Recovery Center (HRRC) and Texas Target Communities (TTC), which involve a network of university students, faculty, first responders, and local community representatives.

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