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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:

COVID-19 and Social Vulnerability: Computational Modeling, Data Analytics, and System Interoperability Working Group

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Working Group Description:

This Working Group intends to model population vulnerability and system-level inoperability in the context of COVID-19. The group will explore how infrastructure systems and processes, along with socio-economic and political mechanisms and institutions, influence individual and collective outcomes from pandemic events. Informed by data, we plan to develop capabilities for interactive simulations of pandemic risk exposures and response mechanisms in the socio-infrastructural systems and processes at various scales. Ultimately, this work aims to inform strategies to mitigate against future events and to provide guidance on optimal approaches for response and recovery.

Priority Research Topics and Specific Research Questions:

Priority Research Topics	Potential Research Questions
1. Pursue impact analysis of suppression and mitigation measures on workforce and on "flattening of the curve."	• How suppression and mitigation measures impact the workforce, and what is the effect on patterns of diffusion of COVID-19.
2. Mobility, social distancing, and the dynamics of COVID-19 infection.	• How mobility impacts of social distancing can be measured at different spatio-temporal resolutions, and how these measures can explain COVID-19 cases.
3. Application of multilevel statistical analysis, survey data collection, and agent-based modeling to analyze the role of social vulnerability in a pandemic.	• How pre-existing social vulnerability conditions and socio-economic disparity can be modeled to analyze the impact of COVID-19 and similar adverse events.
4. The political dynamics of social distancing.	• How do the messages conveyed by scientists and politicians affect individual compliance with social distancing measures?

5. The hydro-climatic and environmental linkages of COVID19 spread.	• What are the hydro-climatic and environmental linkages of COVID-19 occurrence and spread?
6. Comparative analysis of multi-hazard scenarios.	• Comparing food supply chain issues and demand in Puerto Rico caused by the economic shutdown due to COVID-19, with similar demand for emergency resources for Hurricane Maria and the earthquakes.
7. Spatial analysis of COVID 19 and disadvantaged communities.	• Performing spatial analysis of COVID-19 and its intersections with spatial distribution of disadvantaged communities. Comparison with historical exposure of communities to pollution and other environmental stressors that have been found to be correlated with high COVID 19 mortality will be included in this assessment.
8. Institutions and pandemic response, recovery, and mitigation.	• Looking at the role of institutions in pandemic outcomes for vulnerable groups and how they might hinder or enable these populations' participation in decision making processes for response, recovery and mitigation.
9. Resources, risks and non-compliance with recommended public health practices.	• Analyzing to what extent the non-compliance behavior is due to resource constraints and to what extent it is due to risk perception and risk communication challenges.
10. Impacts of COVID-19 in the Global South.	• Understanding the impacts of COVID-19 on the lives and livelihoods in the Global South to the prolonged lock-down measures.

Ethical / Methodological Considerations:

We believe that our understanding of the COVID-19 pandemic crisis should be approached through a combination of robust statistical analysis tools and computational models. This approach has key advantages in understanding the factors contributing to the spread of COVID-19 and the potential consequences of mitigation and prevention strategies.

People are impacted by the pandemic differently and are naturally organized at more than one level (i.e., this is what we define as nested data). The preliminary analysis has shown a hierarchical or clustered structure for the infected and their communities. For example, people belonging to the same race tend to be more alike in social and economic characteristics than individuals chosen at random from the population at large. This has profound ethical consequences for the study of COVID-19, which can involve marginalized, or soon-to-be marginalized, communities. The research community needs to be aware of these dynamics during data gathering and the dissemination of its results or policy interventions.

Unlike most quantitative models currently used to predict the spread of COVID-19, our research will not favor simple equilibrium or monofactorial growth curves. We intend to study and simulate the dynamic, multifactorial, emergence of infection growth from the lower (micro-) network level to a higher (meso-) urban or (macro-) global level. The interaction of usual socio-economic factors can lead to complex consequences because infection dynamics at the collective level are more complex than the dynamics of individual risk functions summarized by simple indicators such as R0, and therefore require a nuanced understanding.

Contributors:

Andrea Molle, Chapman University
Pallab Mozumder, Florida International University

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