

EXCEADS Modelling for Simulating Spillover Effect in Infectious Disease Spread

Niharika Chandna¹, Dr. Srin Venkatrmanan² and Dr. Jiangzhou Chen²

University of Virginia School of Engineering and Applied Sciences¹ and
UVA Biocomplexity Institute

Introduction

Background

•During the COVID-19 outbreak, the Biocomplexity Institute, particularly the COVID-19 Scenario Modeling Hub, played a critical role in supporting state and federal agencies such as the Virginia Department of Health and the U.S. military. By running large-scale simulations, they helped evaluate public health interventions and policy decisions.

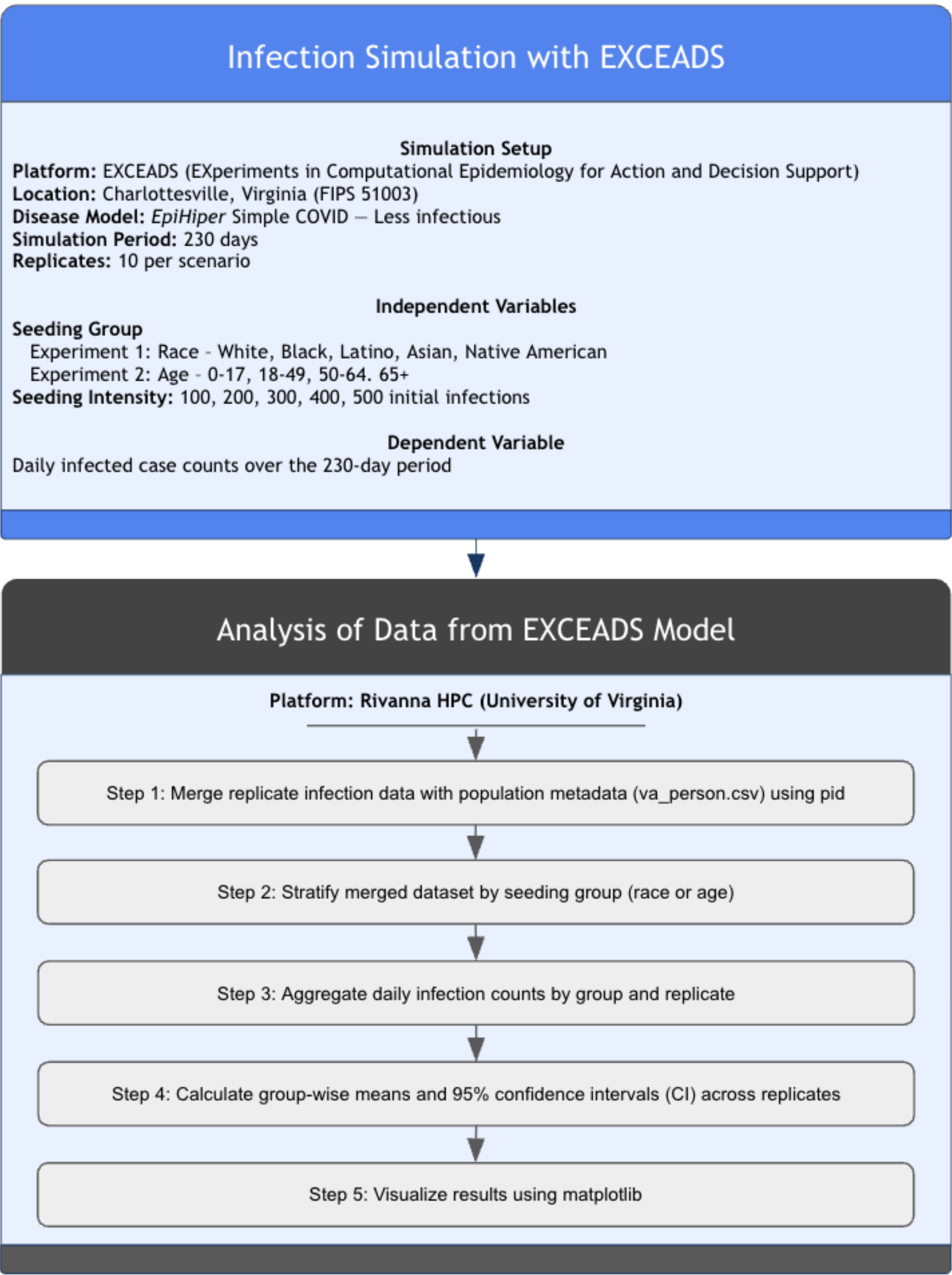
Goal for the summer:

Design and execute custom simulations on EXCEADS platform to study how heterogeneities in demographic factors (e.g. race and age) and initial infection conditions influence epidemic outcomes

This project focuses on exploring Spillover or Network Effects – The indirect impact that an action on one group can have on other groups in the network

- Subpopulation level → Simulate seeding infections or interventions in one subpopulation and track how infections spread across the group
- Negative example: Delayed school closures may lead children to transmit the infection to older adults
- Positive example: Implementing interventions in dense urban centers may reduce infections in surrounding rural areas.

Methods



Metadata: va_person.csv from Virginia Pathogen Genomics Center of Excellence

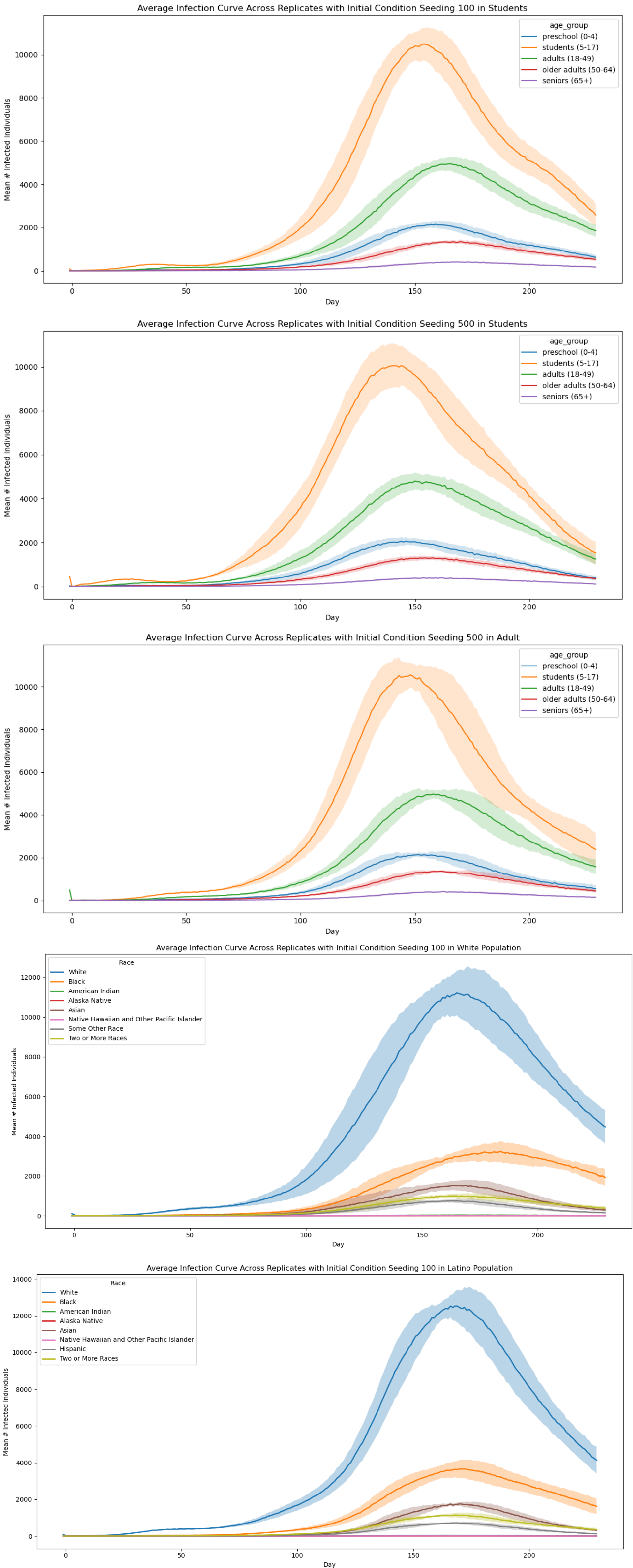
References

Chang, S., Damir Vrabac, Leskovec, J., & Johan Ugander. (2023). Estimating Geographic Spillover Effects of COVID-19 Policies from Large-Scale Mobility Networks. *Proceedings of the ... AAAI Conference on Artificial Intelligence*, 37(12), 14161–14169. <https://doi.org/10.1609/aaai.v37i12.26657>

Ma, K. C., Menkir, T. F., Kissler, S., Grad, Y. H., & Lipsitch, M. (2021). Modeling the impact of racial and ethnic disparities on COVID-19 epidemic dynamics. *ELife*, 10. <https://doi.org/10.7554/elife.66601>

Pilehvari, A., You, W., Chen, J., Krulick, J., Venkatramanan, S., & Marathe, A. (2021). *Differential Impact of Social Distancing on COVID-19 Spread in the U.S.: By Rurality and Social Vulnerability*. <https://doi.org/10.21203/rs.3.rs-798357/v1>

Results



Next Steps/Relevance

1. Use contact data to understand spread between populations
2. Run on other subpopulations or by location (urban vs rural)
3. Analyze current data and determine the implications in the given context (Charlottesville is a high student population)
4. Apply interventions in subpopulations and model spillover effect in those terms to compare to no interventions