Leveraging Social Network Analysis and Mobility Data for Modeling Epidemic Spread in Urban Tourist Destinations

Nitika Pathania[1*], Brian Labus[2] and Shaikh Arifuzzaman[1*]

[1]Department of Computer Science, University of Nevada, Las Vegas (UNLV), 4505 S Maryland Pkwy, Las Vegas, 89154, NV, USA.
[2]Department of Epidemiology and Biostatistics, University of Nevada, Las Vegas (UNLV), 4505 S Maryland Pkwy, Las Vegas, 89154, NV, USA.

*Corresponding author(s). E-mail(s): pathania@unlv.nevada.edu; shaikh.arifuzzaman@unlv.edu;
Contributing authors: brian.labus@unlv.edu;

Abstract

This paper introduces a novel approach integrating social network analysis (SNA) with data-driven simulation models to understand and predict the spread of infectious diseases in Las Vegas, a major global tourism destination. Using real-world transportation data from the Regional Transportation Commission (RTC) of Southern Nevada, together with demographic, geographic, and social connectivity information, our study constructs a comprehensive simulation framework that captures the complex interactions among diverse population groups, including residents, tourists, and hospitality workers. Employing graph theory and machine learning techniques, we identify critical mobility hubs and social interaction hotspots, such as the Las Vegas Strip, casinos, airports, hotels, and entertainment venues, where dense social interactions significantly heighten transmission risks. The model highlights the structural and behavioral aspects of disease diffusion through urban networks, providing actionable insights for targeted public health interventions and strategic epidemic response planning. Experimental results emphasize how targeted strategies focusing on identified network hubs can considerably mitigate disease spread. The developed methodology, blending mobility patterns and social network characteristics, offers a scalable and transferable solution for epidemic preparedness, applicable to other similar urban centers.

Keywords: Social Network Analysis (SNA), Epidemic Modeling, Human Mobility, Graph Theory, Machine Learning, Infectious Disease Spread, Urban Networks