Influential factors of intercity patient mobility and its network structure in China

Jiaqi Ding¹,2, Yang Chao³,⁴,⁵, Yueyao Wang¹,2, Pengfei Li⁵, Fulin Wang⁶,⁷,⁸, Yuhao Kang⁹, Haoyang Wang¹⁰, Ze Liang¹,², Jiawei Zhang¹¹, Peien Han¹¹, Zheng Wang¹,², Erxuan Chu¹², Shuangcheng Li¹,², and Luxia Zhang³,⁴,⁵

¹Peking University, College of Urban and Environmental Sciences, Beijing, China (jiaqiding.ricky@gmail.com)
²Key Laboratory for Earth Surface Processes of the Ministry of Education, Peking University, Beijing 100871, China
³Renal Division, Department of Medicine, Peking University First Hospital, Peking University Institute of Nephrology, Beijing 100034, China
⁴Research Units of Diagnosis and Treatment of Immune-mediated Kidney Diseases, Chinese Academy of Medical Sciences, Beijing 100034, China
⁵Advanced Institute of Information Technology, Peking University, Hangzhou 311215, China
⁶Institute of Medical Technology, Peking University Health Science Center, Beijing 100191, China
⁷National Institute of Health Data Science at Peking University, Beijing 100191, China
⁸Peking University First Hospital, Beijing 100034, China
⁹GeoDS Lab, Department of Geography, University of Wisconsin-Madison, Madison, WI 53705, United States
¹⁰School of Mathematics and Statistics, University of New South Wales, Sydney, NSW 2052, Australia
¹¹Department of health policy and management, School of public health, Peking University, Beijing 100191, China
¹²Faculty of Geographical Science, School of Geography, Beijing Normal University, Beijing 100875, China

Intercity patient mobility reflects the geographic mismatch between healthcare resources and the population, and has rarely been studied with big data at large spatial scales. In this study, we investigated the patterns of intercity patient mobility and factors influencing this behavior based on over 4 million hospitalization records of patients with chronic kidney disease in China. To provide practical policy recommendations, a role identification framework informed by complex network theory was proposed considering the strength and distribution of connections of cities in mobility networks. Such a mobility network features multiscale community structure with “universal administrative constraints and a few boundary breaches”. We discovered that cross-module visits which accounted for only 20% of total visits, accounted for >50% of the total travel distance. The explainable machine learning modeling results revealed that distance has a power-law-like effect on flow volume, and high-quality healthcare resources are an important driving factor. This study provides not only a methodological reference for patient mobility studies but also valuable insights into public health policies.