Integrating Climate and Environmental Exposures to Improve Risk Prediction of Infections after Kidney Transplantation

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Abstract

Infections occur in nearly 10,000 kidney transplant (KT) recipients annually and are the second-leading cause of death among KT recipients. However, current risk stratification tools are unable to identify high-risk individuals who might benefit from more tailored immunosuppression management or targeted anti-infectious prophylaxis regimens. There is a pressing clinical need to identify novel risk factors for post-KT infection to identify potentially modifiable factors to decrease infection risk and to improve infection risk prediction. We aim to inform this knowledge gap by creating a linked, deeply phenotyped dataset of more than 120,000 kidney transplants recipients by combining patient-level clinical and transplant data from the USRDS (national transplant registry data), place-based social determinants of health from the American Community Survey, and extreme heat and air pollution exposure data from NASA/NOAA. Infection outcome data will be ascertained from USRDS using ICD-9/10 codes.

The goal of this Pilot Project is to generate preliminary data for a subsequent K08 application to provide formal training in climate and environmental exposure science and lay the groundwork for future R01 proposals studying the impact of climate and environmental exposures on human health, with a focus on high-risk and vulnerable populations such as transplant recipients. In this study, we aim to quantify the impact of extreme heat and air pollution exposure on post-KT infection risk (Aim 1) with time-to-event analyses using hierarchical regression and distributed lag models. We will then characterize the synergistic impact of place-based social determinants of health (e.g., degree of poverty, education, transportation) with climate and environmental exposures on post-KT infection risk (Aim 2) in this vulnerable population using interaction analysis. Finally, we will create a novel post-KT infection risk prediction model using a deep neural network (Aim 3) to identify high-risk individuals who might benefit from tailored immunosuppression or targeted anti-infectious prophylaxis regimens.