INNOVATING CROSS-DOMAIN SOLUTIONS TO DETECT EMERGING BIOLOGICAL THREATS

PSIDO: Predictive Surveillance Of Infectious Disease Outbreaks

Katharine Jennings Noblis **Katharine Jennings** Noblis **Blaise Arbogast** Noblis **Fanwei Zeng** Noblis
T.C. Folkedal Noblis **Lauren Moore** Noblis **David Ashford** Noblis ESI **Loren Shaffer** Noblis ESI
Anna Swiatecka Noblis ESI

Outbreaks of infectious diseases following weather events are frequently reported, but only after disease occurs in affected populations; often late in the epidemiological curve[1]. Precipitation-producing weather events are increasing due to climate change. Noblis hypothesizes that the capacity to predict weather-correlated outbreaks would improve defense mission readiness and reduce morbidity and mortality. The objectives of this study are to develop and demonstrate a model that accounts for overlooked weather-related variables in infectious disease outbreaks, and output data that predicts infectious disease(s) likely to coincide with weather sufficiently far enough in advance to enable better preparations.

Our initial exploratory assessment using data from several sources shows evidence of correlations between specific weather patterns and upticks in the spread of infectious diseases[2],[3],[4]. This observation matches our hypothesis that vector-borne illnesses spread largely by mosquitos will show strong positive correlation with weather producing standing water and temperatures consistent with mosquito blooms. Our research will apply machine learning algorithms to this problem by better identifying specific relationships between weather and disease outbreaks (e.g., the lag period between rain and mosquito bloom) to better inform disease prevention efforts. Ultimately utilizing predicted/occurring weather we propose to predict disease threats early enough to intervene.
Our preliminary research shows that in Texas, Dengue fever, West Nile fever, and St. Louis encephalitis rates appear to coincide with areas having larger mosquito populations after major precipitation events. Our initial analyses show sufficient promise to continue developing our analytical and predictive models. We believe we can provide extremely valuable insights using a combination of the anticipation, and subsequent confirmation, of weather for a given area, coupled with adequate disease data, in conjunction within our ML models. This information addresses the risk factors underlying the ecology and population dynamics of the arbovirus vectors leading to disease outbreaks. As climate change spurs more frequent and severe weather events, the need also increases for weather-related arbovirus outbreak predictive modeling supported by high-quality underlying data sources.

During early engagements with potential end users, Noblis determined that DoD has a high interest in climate impacts on international military installations and deployment areas. Warfighters need to be able to operate in dangerous environments, and understanding when and where the risks of arboviral disease are greatest enables appropriate protections before operations commence, reducing morbidity and mortality and improving operational outcomes.

[1] Kouadio IK et al. Expert Rev Anti Infect Ther. 2012 Jan;10(1):95-104.
[2] Coalson JE et al. Environ Health Perspect. 2021 Sep;129(9):96002.
[3] Kontowicz E et al. Journal of Environmental and Public Health. 2022 Jun: Article ID 8777594.
[4] Chowell G et al. Phil. Trans. R. Soc. B 374: 20180272.