

# Winter Respiratory Risk Prediction Model in Adults: A UK LLC Based Longitudinal Cohort Analysis

Ruonan Pei<sup>1</sup>, Dr Catalina Vallejos<sup>2,3</sup>, Prof Sir Aziz Sheikh<sup>1,4</sup>, Dr Ting Shi<sup>1</sup>  
<sup>1</sup> Centre for Medical Informatics, Usher Institute, University of Edinburgh, Edinburgh, UK  
<sup>2</sup> Alan Turing Institute, London, UK  
<sup>3</sup> MRC Human Genetics Unit, Institute of Genetics and Cancer, University of Edinburgh, Edinburgh, UK  
<sup>4</sup> Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, UK



## Background

- Respiratory infections pose a major challenge during winter
- Winter respiratory diseases (WRDs) include acute respiratory diseases, respiratory viral infections triggered exacerbation on chronic conditions
- Vulnerable populations (older adults, pre-existing conditions) are at greater risk on winter respiratory diseases
- Understanding winter respiratory risks are important for targeted preventive actions and early treatment

## Aims

To develop and validate a robust risk prediction model for winter respiratory disease (WRD)-related hospitalisations, Accident and Emergency (A&E) attendances, and mortality

## Methods

### Study Population & Data

Adults (≥18 years), 2017-2025

Data source: 16 longitudinal cohort studies hosted by *UK Longitudinal Linkage Collaboration (UK LLC)*, a Trusted Research Environment for data linkage in longitudinal research

### Exposures & Outcomes

Exposures: Acute respiratory diseases and viral-triggered exacerbations of chronic conditions

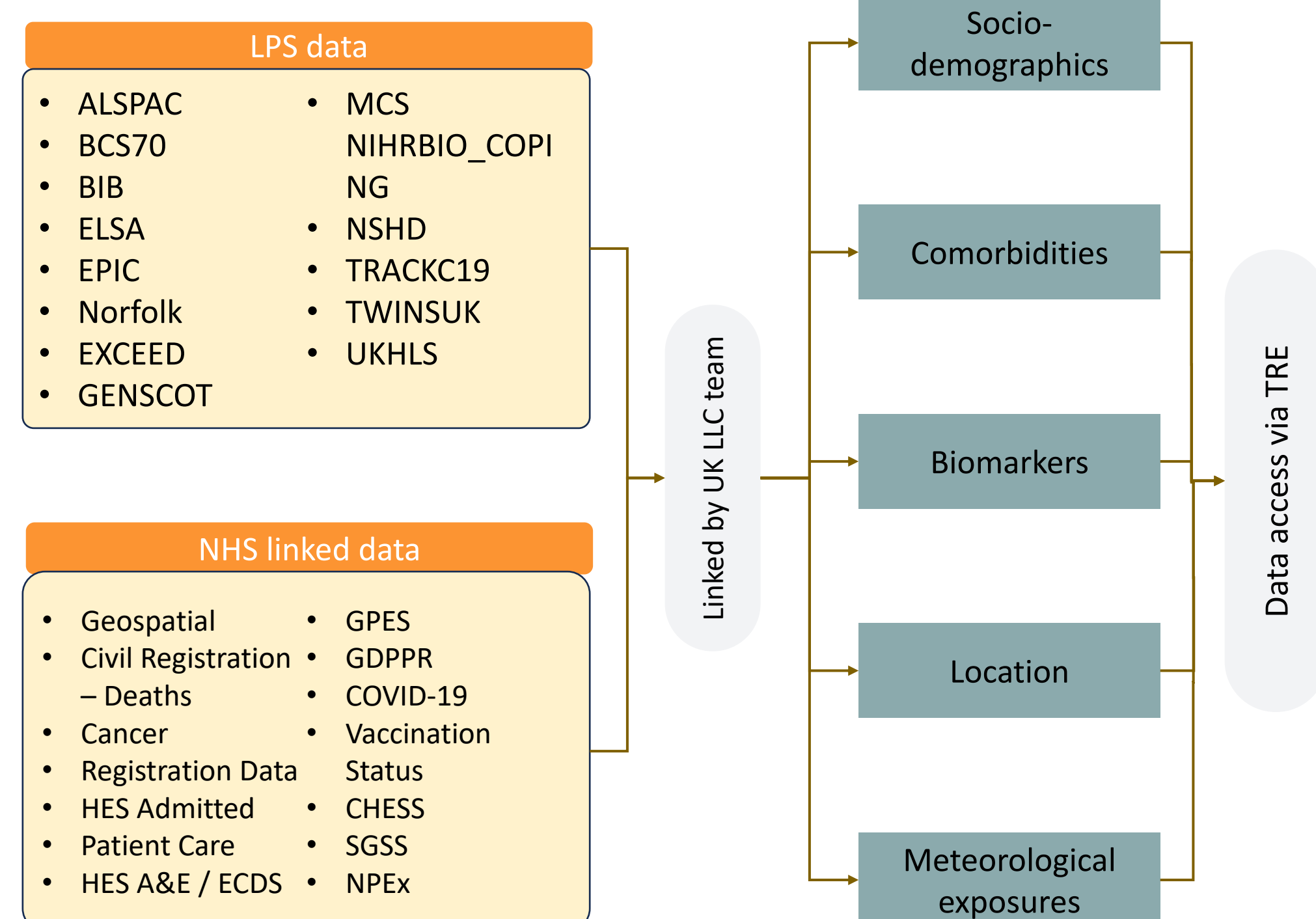
Outcomes: WRD-related hospitalisation, A&E usage, and 28-day post-hospitalisation mortality

### Methods

Logistic regression (benchmark), XGBoost-derived survival models, Generalised Additive model, Random survival forest

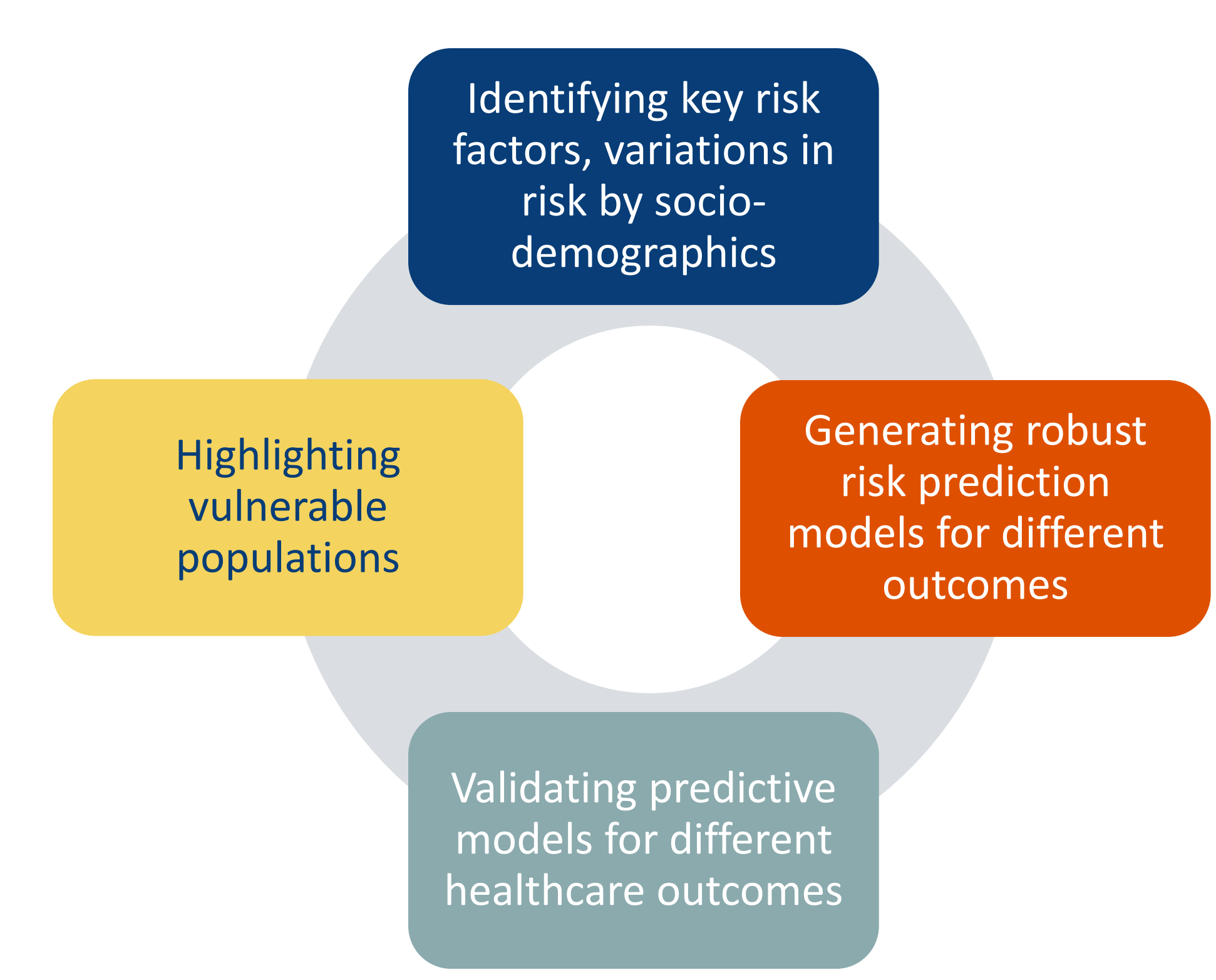
### Model Evaluation

Concordance statistics and Calibration-in-the-large  
Ensemble models compared with single models; the final tool selected based on superior performance



Flowchart of data requirements and covariate types from UK LLC to end users

## Expected results



## Impacts to the publics

- Identify vulnerable population and support early intervention
- Reduce the severity of winter respiratory disease at the early stage
- Facilitate the allocation of healthcare resources
- Reduce winter pressure on NHS

## Conclusions

This research will provide a robust, data-driven tool to predict risks for hospitalisations, unscheduled care, and mortality associated with winter respiratory diseases in adults, enabling healthcare systems in Scotland to allocate resources effectively and implement targeted interventions, ultimately reduce the pressure on healthcare system during wintertime.

**Conflict of interest:** No conflict to be acknowledged