To assess the effect of long-term exposure to PM$_{2.5}$, NO$_2$, and ozone on first hospital admissions with myocardial infarction (MI), chronic obstructive pulmonary disorder (COPD), heart failure (HF), pneumonia, stroke, and lung cancer for Medicare participants across the United States using a novel doubly robust additive hazards model (DRAHM).

We used a doubly robust additive hazard model (DRAHM) to assess the effect of long-term exposure to PM$_{2.5}$, ozone, and NO$_2$ on hospital admissions for stroke, myocardial infarction (MI), lung cancer, heart failure, pneumonia, and chronic obstructive pulmonary disease (COPD) among Medicare fee-for-service participants from 2000 to 2016. This model is unbiased if either the inverse probability weight (IPW) model for exposure or the outcome regression model are correctly specified. It also does not require a proportional hazards assumption. PM$_{2.5}$, ozone, and NO$_2$ levels were obtained from previously validated high-resolution prediction models which utilized machine learning algorithms. These predictions were averaged spatio-temporally to obtain annual exposure on a zip code level. Admission information was assessed using discharge diagnosis codes from the Medpar database. Covariates included demographic and socioeconomic variables. Demographic information was obtained from the Medicare denominator file and socioeconomic variables were obtained from census and survey data. Effect measure modification was assessed for sex, age, race, and socioeconomic variables. We then repeated the analyses among observations that were less than the federal standard of 12 mcg/m$^3$ for PM$_{2.5}$, 53 ppb for NO$_2$, and below 70 ppb on all days of the year for ozone. Here we present our preliminary analysis for PM$_{2.5}$ and NO$_2$ and MI from 2000 to 2013.

Our preliminary results reveal an increase in the hazard of admission with myocardial infarction among Medicare beneficiaries on an additive scale with exposure to PM.

---

DRAHM Equation

\[- \ln[1 - E(D_{ij} | x_{ij}, v_{ij})] = \beta_0 + \beta x_{ij} + s(v_{ij}, y), \text{weights}_{ij} = SW_{ij}\]