Title: Evaluating Covariate Lookback Times and the Impact on performance of Patient Level Prediction Models

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INTRO: **The aim of this study is to conduct an empirical evaluation to determine the best covariate lookback for developing generalizable prognostic models.**
In a Korean study with data from the National Health Insurance Database evaluating in hospital mortality for patients aged 40 and older who underwent percutaneous coronary intervention the authors' compared comorbidity measurements (Charlson comorbidity index, Elixhauser's comorbidity, and comorbidity selection) using three years of inpatient records compared to models using one year of inpatient records and concluded the longer lookback period offered no improvement in predictive capacity [1]. Evaluation of the impact of one year vs. two-year lookback in Charlson score for mortality among elderly Medicare beneficiaries using claims data reported nearly identical C-statistics [2]. An Australian study using population-based hospital data examined prediction of hemorrhage in pregnancy among eight different chronic disease cohorts and evaluated six lookback periods and concluded that although longer ascertainment periods resulted in improvement of identification of chronic disease history it did not change the resulting C-statistics [3]. The intent of this study is to evaluate the performance of prediction models using acute and chronic disease cohorts and using several lookback periods and multiple observational datasets to provide recommendations for the optimal lookback period.

METHODS: Five US observational databases were used in this study: (IBM MarketScan® Commercial Claims and Encounters (IBM CCAE); Multi-StateMedicaid Database (IBM MDCD); Medicare Supplemental and Coordination of Benefits Database (MDCR); Optum© De-Identified Clinformatics® Data Mart Database – Socio-Economic Status (Optum SES) ; Optum® de-identified Electronic Health Record Dataset (Panther)
NOTE: all databases were transformed to the Observational Medical Outcomes Partnership Common Data Model. The use of Optum and CCAE was reviewed by the New England Institutional Review Board and was determined to be exempt from broad Institutional Review Board approval as this project did not involve human subject research.

Analyses: Prediction was performed using the PatientLevelPrediction package and LASSO logistic regression. Seven time periods (14, 30, 90, 180, 365, 730, and all days prior to index) were evaluated. The AUC was calculated using 10 different test/train splits per time period to calculate mean AUC and 95% confidence intervals. A single model from each time period was externally validated.

Target Cohorts	Outcome Cohorts
New users of hypertension drugs – no prior stroke	Stroke (ischemic or hemorrhagic) events, no IP or ER visit
New users of hypertension drugs – no prior diabetes mellitus	Diabetes
Cohorts built using data between 2016 and 2019; Subjects were required to have at least 365 days of prior observation; Target cohorts required a drug exposure of one or more hypertension drugs, for the first time in a person's history, and at least 1 diagnosis claim for hypertensive disorder 0-365 days prior to index.	

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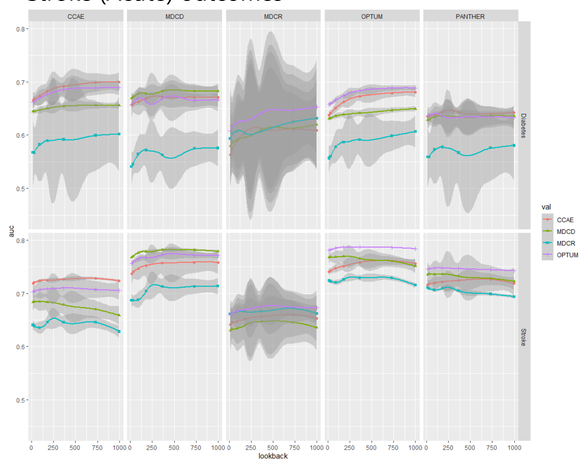
Shorter lookback time for the acute outcome, stroke results in equivalent performance as using longer lookback times.

A lookback time of at least 365 days for the chronic outcome, diabetes results in equivalent performance as using lookback times greater than 365 days.

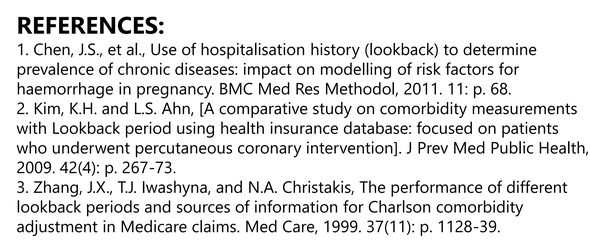
RESULTS:

Figure 1. Discrimination: Scatterplot of lookback time (x) vs. AUC (y) for Diabetes (Chronic) and Stroke (Acute) outcomes



NOTE: training database is represented in columns, colors represent the external validation database

Figure 2. Mean Predictors: Scatterplot of lookback time (x) vs. mean predictors (y) for Diabetes (Chronic) and Stroke (Acute) outcomes



IMPORTANT LEARNINGS:

Discrimination: In diabetes, general discrimination improvement up to 365d but then it stays stable or improves marginally in CCAE, MDCD, Optum but MDCR has different pattern (continuous increase). In stroke, performance is more stable earlier on in CCAE, MDCD, Optum, and MDCR.

Mean Predictors: In diabetes, the mean number of predictors increases with lookback time and the largest number of predictors were utilized in CCAE and the smallest number of predictors in MDCR.
In stroke, the mean number of predictors follows a similar pattern to stroke however overall fewer numbers of predictors are included in the final models.

REFERENCES:

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