

**Conclusions:** A novel application of unsupervised ML in cardiac surgical patients identified a high mortality cluster otherwise missed by traditional classification. This high mortality cluster warrants further research to understand the typical patient journey and support treatments that may reduce the mortality rate.

### ML2 SUPERVISED MACHINE LEARNING PREDICTS MORTALITY IN COVID-19 PATIENTS USING ELECTRONIC HEALTH RECORDS

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**Objectives:** This study implements supervised machine learning (ML) to predict mortality in COVID-19 patients and determine the important features in this prediction. **Methods:** Patients were selected from a large US electronic health records database (Cerner Real-World Data) that contains over 87 million patients. We investigated the first in-patient visit for patients with a COVID-19 diagnosis and lab results identified in the database, and with a length of stay of at least 24 hours, non-missing gender, and age between 18 and 90 years. Patient characteristics, hospital characteristics, Charlson Index, quick sequential organ failure assessment (qSOFA), treatments (e.g., mechanical ventilation) and lab values (e.g., minimum white blood cell count) were included in this analysis. Several ML algorithms were compared through 10-fold cross validation. The best performing algorithm was tuned and evaluated with a test dataset. Feature importance was extracted from the final model through permutation importance. **Results:** There were 55,045 patients included in this study. The ML algorithms that were compared included (mean cross-validation accuracy  $\pm$  cross-validation standard deviation): logistic regression (78.3%  $\pm$  0.4%); random forests (87.4%  $\pm$  0.5%); extreme gradient boosting (XGBoost) (88.1%  $\pm$  0.5%); and support vector machines (83.1%  $\pm$  0.4%). XGBoost was selected for the final model, which after hyperparameter tuning, had a prediction accuracy of 88.3%. The final model had an F1 score of 0.57, an area under the receiver operator characteristic curve (AUC ROC) of 0.90, a precision of 0.65, and a recall of 0.50. The top five most important features in this prediction were mechanical ventilation, age, minimum white blood cell count, qSOFA, and maximum temperature. **Conclusions:** Supervised ML was able to perform well in predicting mortality in COVID-19 patients, while identifying the most important features in prediction. Similar ML algorithms may identify higher risk COVID-19 patients earlier in the hospital for additional monitoring and treatment consideration.



### ML3 LASSO (LEAST ABSOLUTE SHRINKAGE AND SELECTION OPERATOR) AND XGBOOST (EXTREME GRADIENT BOOSTING) MODELS FOR PREDICTING DEPRESSION-RELATED WORK IMPAIRMENT IN US WORKING ADULTS

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**Objectives:** Work productivity loss among adults with depression are associated with multiple patient characteristics. The current study examined predicted total work impairments as a result of absenteeism and presenteeism using regularized linear regression and decision-tree-based ensemble algorithm. **Methods:** Data on employed US adults (18–64 years old) were analyzed from the 2019 National Health and Wellness Survey. Analysis sample included respondents who self-reported diagnosis of depression or having experienced depression in the past 12 months. Work productivity loss was derived from Work Productivity and Activity Impairment questionnaire. Group LASSO with Nesterov's method and XGBoost regression were used separately to predict work impairments and to extract model feature importance views. Given the count-like nature of productivity loss, poisson distribution was specified in both LASSO and XGBoost. Variable selection was based on model fit statistics Akaike Information Criterion (AIC) (LASSO) and the gain in feature importance (XGBoost). Forty variables on respondent demographics, health behavior (e.g., smoking and alcohol use), depression-related variables, comorbidities, and doctor visits were entered into both models. Data was split into training, validation, and testing datasets. Hyperparameters were tuned based on the validation data. Root mean squared errors (RMSE) for the testing data were compared to assess model performance. **Results:** Among 11,478 working adults with depression, XGBoost made more accurate predictions compared with LASSO (RMSE=26.6 and 27.6, respectively). Overestimation of impairment was slightly greater in the LASSO model compared with that from XGBoost (mean impairment=33% and 30%, respectively). The LASSO model selected more demographic and health behavior variables than XGBoost which



ranked comorbidity variables (arthritis, sleep conditions, migraine, liver or renal diseases) as the most important features in predicting productivity loss. **Conclusions:** In a broadly representative US population of working adults with depression, XGBoost model was found to better predict productivity loss compared with LASSO.

### ML4 ASSOCIATION OF INCIDENT CANCER WITH LOW-VALUE CARE AMONG ELDERLY MEDICARE BENEFICIARIES USING MACHINE LEARNING

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**Objectives:** In the United States (US), 25% of healthcare spending is considered wasteful because it is spent reimbursing low-value care. Low-value care is the utilization of healthcare services, medical tests, and procedures that have unclear or no clinical benefit to patients, but still exposes them to risk. This study aims to evaluate the association of incident breast, prostate, colorectal and Non-Hodgkin's cancer to low-value non-cancer care among older US adults enrolled in Medicare using machine learning methods. **Methods:** We used a retrospective cohort study design with 12-month baseline and follow-up periods. We identified two cohorts of cancer and non-cancer patients. We identified relevant low-value services using ICD9/ICD10 and CPT/HCPCS codes. XGboost models were used to identify the leading predictors of low-value care and partial dependence plots to examine the association of the different cancer types to low-value care. **Results:** The combined study cohorts included 529,452 individuals. Overall, the prevalence of low-value care was 24.3%. Rates of low-value care differed significantly by cancer type; the highest rates were observed in Non-Hodgkin's lymphoma (34%) followed by colorectal cancer (29%) while the lowest rates were among patients diagnosed with prostate cancer (22%). The association of cancer to low-value care varied by cancer type; both colorectal cancer and NHL were positively associated with low-value care, but breast and prostate cancers were negatively associated with low-value care. **Conclusions:** One in four older fee-for-service Medicare beneficiaries received low-value care. The leading patient-level predictors of low-value care were fragmentation of care, the number of chronic conditions, and age. Community-level predictors like market characteristics, healthcare utilization, and social determinants of health were also found to be important predictors of low-value care, suggesting that a multipronged approach that targets patient and system-level factors are needed to reduce the risk of low-value care among older adults.



## Medical Technology Studies

### MT1 TELEHEALTH UTILIZATION AND MULTIPLE SCLEROSIS IMAGING UTILIZATION IN FOUR MS CENTERS DURING THE COVID PANDEMIC: REAL-WORLD EVIDENCE FROM THE MS-CQI IMPROVEMENT RESEARCH COLLABORATIVE.

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**Objectives:** To describe care utilization types and related imaging utilization outcomes during the COVID pandemic. **Methods:** Electronic Health Record (EHR) data from four participating MS-CQI centers was abstracted for January–June 2020. Participants were patients with Multiple Sclerosis (PwMS)  $\geq$ 18 years who were seen either in person or via a telehealth method such as phone or video. Chi-square tests were used to assess associations across centers and different types of telehealth utilization variables. ANOVA was used for continuous variables. Associations between 3 types of magnetic resonance imaging (MRI) utilizations [brain MRI (bMRI), cervical MRI (cMRI), and thoracic MRI (tMRI)] and care delivery type (telehealth or in-person) were assessed using binary logistic regression. **Results:** The study included 1,866 PwMS with the majority being female (75%), having RRMS (81%), and an average age of 49 years. 1,014 patients used a telehealth method during the time period whereas 852 patients utilized in-person physician visits. Controlling for covariates, regression analyses identified significant center effects on MRI imaging usage during the pandemic. Telehealth utilizers had greater odds of using imaging services compared to in-person utilizers for brain MRI (bMRI), cervical MRI (cMRI),

