

**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

**Marinero X,** Meng Z, Zhang X, Lodaya K, Hayashida DK, Munson S, D'Souza F

*Boston Strategic Partners, Inc., Boston, MA, USA*

**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

**Li V,** Costantino H,<sup>1</sup> Rowland J,<sup>2</sup> Yue L,<sup>3</sup> Gupta S<sup>1</sup>

*<sup>1</sup>Kantar, New York, NY, USA, <sup>2</sup>Kantar, Bronx, NY, USA, <sup>3</sup>Kantar, Jersey City, NJ, USA*

**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

**Iloabuchi C,**<sup>1</sup> Dwibedi N,<sup>2</sup> LeMasters T,<sup>2</sup> Ladani A,<sup>3</sup> Shen C,<sup>4</sup> Sambamoorthi U<sup>4</sup>

*<sup>1</sup>West Virginia University School of Pharmacy, Robert C. Byrd Health Sciences Center, WV, USA, <sup>2</sup>West Virginia University School of Pharmacy, Morgantown, WV, USA, <sup>3</sup>West Virginia University Medicine, Morgantown, WV, USA, <sup>4</sup>Penn State College of Medicine, Hershey, PA, USA*

**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.

**Chen A,**<sup>1</sup> Molaei M,<sup>2</sup> Vaeth A,<sup>3</sup> Walsh K,<sup>1</sup> Oliver B<sup>4</sup>

*<sup>1</sup>Thomas Jefferson University, Philadelphia, PA, USA, <sup>2</sup>Thomas Jefferson University, Conshohocken, PA, USA, <sup>3</sup>Massachusetts General Hospital; Harvard Medical School, Charlestown, MA, USA, <sup>4</sup>Dartmouth-Hitchcock-Health, Lebanon, NH, USA*

**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),



and thoracic MRI (tMRI) respectively (bMRI OR 3.48; 95% CI: 2.51–4.82; cMRI OR 2.93; 95% CI: 1.94–4.45; tMRI OR 2.50; 95% CI: 1.51–4.14). **Conclusions:** MRI plays a large role in how MS specialists diagnose, treat, and monitor MS. We found that telehealth patients had greater odds of MRI utilization. Due to data limitations, we were unable to control for all potential influencing factors. However, our results suggest future inquiry targeting the differences in patient care practices based on care delivery type related to imaging utilization and related MS population health outcomes.

### MT3

#### ASSESSING THE POTENTIAL VALUE OF WEARABLE DIGITAL HEALTH TECHNOLOGIES IN CHRONIC KIDNEY DISEASE USING EARLY HTA METHODS

Gc VS,<sup>1</sup> Manca A,<sup>1</sup> Casson AJ,<sup>2</sup> Antrobus S,<sup>2</sup> Iglesias CP<sup>1</sup>

<sup>1</sup>University of York, Heslington, York, UK, <sup>2</sup>University of Manchester, Manchester, UK

**Objectives:** Wearable digital health technologies (WDHTs) offer several solutions in terms of chronic disease monitoring, management and delivery of specific interventions. Early HTA methods can inform considerations about the potential clinical and economic benefits of technology in the initial phases of the product's lifecycle, facilitating identification of those R&D investments with the greatest potential stakeholders' payoff. We report our experience of using early HTA methods to support R&D decisions relating to novel WDHT being designed to support self-management of chronic kidney disease (CKD). **Methods:** We performed a literature review, focus-group interviews with stage  $\geq 3$  CKD patients, and qualitative interviews with the prototype development team to understand the relevant characteristics of WDHTs, quantify relevant clinical indications and existing technological constraints. An early economic evaluation was used to identify the key drivers of value for money, and a discrete choice experiment shed light onto patient preferences towards what key features the WDHT should have for the users to adopt it. Then a model-based cost-effectiveness analysis was undertaken incorporating headroom analysis, return on investment, one-way sensitivity and scenario analyses. **Results:** The literature review, focus group discussions with CKD patients, and qualitative interview with technology developer helped to understand relevant characteristics of WDHT and user preferences helped inform the next R&D iteration. Compared to the standard care, WDHT that support stage  $\geq 3$  CKD patients self-management at home by measuring blood pressure and monitor mobility has the potential to be cost-effective at conventional cost-effectiveness threshold levels (that is £20,000–£30,000/QALY). From the headroom analysis, novel WDHT can be priced up to £280 and still be cost-effective compared to standard home blood pressure monitoring. **Conclusions:** Our study provides valuable information for the further development of the WDHT, such as defining a go/no-go decision, as well as providing a template for performing early HTA of Digital Health Interventions.



### Alternative Medicine & Nutrition - Epidemiology & Public Health

#### PAM1

#### WILLINGNESS TO PAY FOR SUGAR-SWEETENED BEVERAGES TAX IN AN AFFLUENT SETTING OF ASIA: A PRELIMINARY FINDING

Chong KC,<sup>1</sup> Wang J<sup>2</sup>

<sup>1</sup>The Chinese University of Hong Kong, Hong Kong, Hong Kong, <sup>2</sup>The Chinese University of Hong Kong, Shatin, Hong Kong

**Objectives:** To assess the tax rates that an individual will change their consumption frequency for sugar-sweetened beverages (SSB) products i.e. Willingness to pay (WTP) **Methods:** We conducted a cross-sectional study via a random telephone survey for adult residents in Hong Kong from May to June, 2020. SSBs products were referred to all non-alcoholic water based beverages with added sugar. WTP of a respondent was defined as the accepted price that he is willing to pay for the SSB products without a reduction of purchase given a taxation scenario, and the maximum WTP (WTP<sub>M</sub>) was defined as the highest accepted price that a respondent consuming SSB products. The questionnaire was designed consisting of socio-demographics, physical conditions, SSB consumption frequency, perception about SSB products, and WTP for each types of SSBs. **Results:** A total of 1,000 subjects were successfully interviewed and the response rate was 59.1%. We found the local population had a high consumption behavior of SSB products and even though a half of them perceived that a consumption of SSB products could contribute a risk of getting chronic diseases, only a moderate proportion of WTP (>60%) at a typical range of taxation (i.e. 5%–10%) was reported. Among the SSB products, we found a comparatively higher proportion of WTP in sweetened tea/coffee and the WTP<sub>M</sub> was less sensitive when the price was increased, primarily due to a regular consumption in the daily lives of local population. Compared with the adults, the proportions of WTP in children were relatively lower indicating a higher effect of SSB tax. **Conclusions:** This is the very first study in the Chinese society to identify determinants for individuals' WTP and evaluate the acceptability of taxation policy on SSB products. The findings thus help with designing SSB tax policy especially in the Chinese population.



### MT4

#### SAFETY WARNINGS ABOUT POWER MORCELLATION IN HYSTERECTOMY: A SIMULATION OF NATIONAL IMPACT

Xu X,<sup>1</sup> Desai VB,<sup>2</sup> Schwartz PE,<sup>1</sup> Gross CP,<sup>1</sup> Lin H,<sup>3</sup> Wright JD<sup>4</sup>

<sup>1</sup>Yale University, New Haven, CT, USA, <sup>2</sup>CooperSurgical Inc., Trumbull, CT, USA, <sup>3</sup>Rutgers University, Newark, NJ, USA, <sup>4</sup>Columbia University, New York, NY, USA

**Objectives:** Laparoscopic hysterectomy has lower perioperative morbidity than abdominal hysterectomy. However, in 2014, the U.S. Food and Drug Administration warned that laparoscopic power morcellation increases tumor dissemination if patients have occult uterine cancer. This has increased use of abdominal hysterectomy. We simulated national health and financial impact of this practice change by accounting for both hysterectomy- and occult cancer-related outcomes. **Methods:** Using the State Inpatient Database and State Ambulatory Surgery and Services Database from Florida, Iowa, Kentucky, Michigan, Minnesota, Nebraska, New Jersey, North Carolina, Oregon, Vermont, and Wisconsin, as well as data from the New York Statewide Planning and Research Cooperative System and New York State Cancer Registry, we examined hysterectomies in the pre-warning (2013Q1–2013Q4) and post-warning (2014Q4–2015Q3) period. Via multivariable regression, we estimated patient outcomes and the counterfactual distribution of hysterectomy route in the post-warning period had there been no morcellation warning. Extrapolating these estimates to the national population and incorporating additional parameter estimates from the literature, we simulated the lifetime costs (societal perspective) and quality-adjusted life-years (QALYs) of patients nationwide in the post-warning period, compared to the counterfactual scenario had there been no morcellation warning. **Results:** The national simulation sample included 360,471 patients age  $\geq 18$  years undergoing hysterectomy for presumed benign indications in the post-warning period. In base-case micro-simulation, the practice change led to more surgical complications but fewer



#### PAM2

#### 30 DAY READMISSIONS OF PATIENTS WITH A MALNUTRITION DIAGNOSIS: EXPLORATION OF THE US HOSPITAL POPULATION

Kindilien S Goldberg E

University of New Mexico, Albuquerque, NM, USA

**Objectives:** Acute and chronic malnutrition is a serious condition known to worsen many healthcare outcomes, delay recovery, and slow return to desired quality of life. This study uses the National Readmission Database (NRD) 2017 data, from the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ) to explore readmission events among patients with an index visit that included a malnutrition diagnosis. **Methods:** Any patient in the NRD who had an ICD-10 code for malnutrition in the first ten diagnoses was included. Patients who had a non-elective hospital readmission within 30-days of discharge from the index visit were flagged for readmission. Major Diagnostic Categories (MDC) were used to classify causes for the index visit and adjusted Wald p-values were used to identify characteristics that were significantly different between those who had a readmission event and those who did not. A weighted, adjusted logistic regression was used to identify characteristics that increase the odds a patient who has an index visit will also have a readmission. **Results:** 407,440 eligible index visits were identified, 94,140 (22.97%) of which were followed by a readmission event. Infectious and parasitic disease and disorders (19.38%) and respiratory system (14.63%) were the most common MDCs assigned at the index visit. Characteristics associated with 30-day unplanned readmissions included age, male gender, and length of stay at the index visit. The presence of stage 2 (aOR: 1.20; 95% CI: 1.14 – 1.27) or stage 3 (aOR: 1.20; 95% CI: 1.13 – 1.26) pressure ulcer at the index event and discharge against medical advice (aOR: 1.84; 95% CI: 1.73 – 1.97) were also significant. **Conclusions:** 30-day readmissions are common following an index visit that included a diagnosis of malnutrition. Provision needs to be made

