Telehealth Utility Model: a Tool for Improving Patient Care in Rheumatology

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Data Science Fellowship Program

Background

- The COVID-19 pandemic catalyzed the rapid adoption of telehealth in rheumatology practices worldwide.
- Our group developed a novel scoring system called the Encounter Appropriateness Score for You (EASY), in which providers document their perception of the appropriateness of telehealth or in-person care after every encounter. EASY score is defined:
    1. Either in-person or telehealth acceptable
    2. In-person preferred
    3. Telehealth preferred
- An analysis of over 12,000 EASY scores in our practice demonstrated that approximately 30% of all follow-up visits could be done by telehealth.

Goal

- Expand access to telehealth care by developing a predictive model that could identify future visits appropriate for telehealth rather than in-person care via the EASY score.

Data

- Analyzed return visits to Duke Rheumatology with a documented EASY score.

Methods

Model:
- Predicts telehealth appropriateness via EASY score defined as a binary variable:
    - (1) Telehealth
    - (0) In-Person
- Developed with 10-fold cross-validated logistic regression on a randomized 70/30 train/test partition.
- Covariates include (1) Patient sociodemographic characteristics, (2) Patient Clinical Characteristics, (3) Encounter Characteristics and (4) Provider Characteristics.

Pilot Implementation:
- Presented 4 providers with future visits from 3/1/22 – 7/31/22 that the model recommended a change in visit modality (n=201).
- Half of the presented recommendations are real suggestions to change from the model, the other half are artificially recommended changes.
- The providers could accept or reject the proposed change in encounter type.
- If the provider accepted the change, the patient is given an opportunity to accept or reject the proposed change of their upcoming visit modality.

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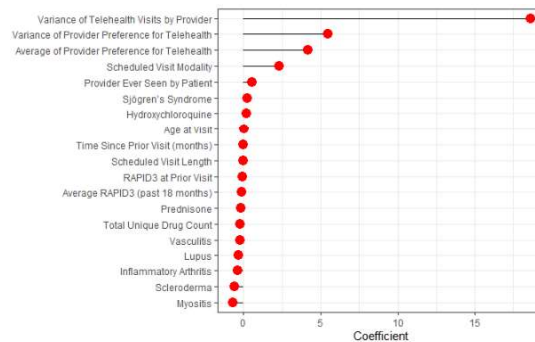## Results – Model Performance

Figure 1: Dot chart of the coefficients of the 19 statistically significant covariates in the telehealth utility model. Sorted from largest to smallest coefficient.
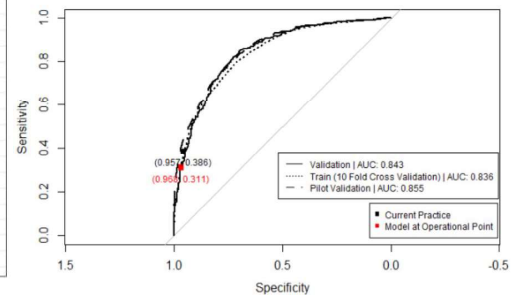
Figure 2: ROC curves for the Train, Validation and Pilot Validation data cohorts.

Data Cohort	Telehealth Predicted	AUC	Average Precision	Recall	Accuracy
Train 1/1/2021 – 12/31/2021	0.150	0.836 (0.828, 0.844)	0.711 (0.691, 0.723)	0.373 (0.358, 0.390)	0.770 (0.762, 0.778)
Validation 1/1/2022 – 1/31/2022	0.117	0.843 (0.819, 0.866)	0.703 (0.653, 0.750)	0.311 (0.263, 0.358)	0.769 (0.746, 0.794)
Pilot Validation 3/1/2022 – 7/31/2022.	0.069	0.855 (0.843, 0.866)	0.705 (0.673, 0.722)	0.250 (0.227, 0.276)	0.807 (0.796, 0.817)

Table 1: Performance metrics for the Train, Validation and Pilot Validation data cohorts.

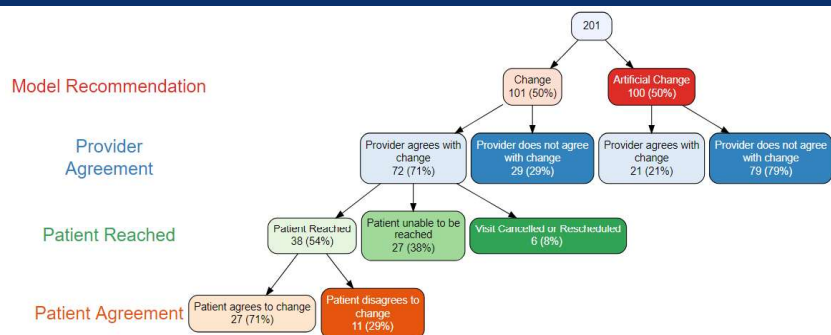## Results – Pilot Implementation

Figure 3: Flowchart of provider and patient agreement during the stages of pilot implementation.

- Percent of provider agreement among the true changes from the model 72/101 (71%) was higher than the rate of agreement with the randomly selected artificial changes 21/100 (21%)
- Unweighted Cohen's Kappa = 0.50, p<0.001 provides evidence that there is moderate agreement between the provider and the model on whether the encounter modality should be changed
- Of the 72 visits in which the provider accepted a true change, the patient was reached by clinic staff in 38 visits (54%). Of those, 27/38 (71%) patients agreed to the recommended change, where 26 of the 27 visits changed from In-Person to Telehealth.

DEI Discussion

- Gender and Insurance variables were statistically significant predictors during model development. However, model performance was not impacted when these variables were removed from the model.

Conclusion

- Provider level aggregate covariates are the most impactful in increasing the probability of a telehealth prediction.
- Consistent performance of the model across all of the data cohorts supports the goal for the model to maintain current performance for future predictions on the target population.
- Rates of patient agreement with the true model recommendations shows that patients are willing to change their visit modality as a result of the model's suggestion.