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Forecast Pharmacy Cost Using Demographics, Therapeutic Conditions and Historical Pharmacy Cost

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Background

- Predicting health care costs for individuals is essential for managed care.
- By identifying high cost members, plan sponsors can perform targeted interventions designed to address each member's unique needs and improve patient outcomes.
- Numerous forecast pharmacy models exist, but not all adequately address the complex needs of each plan sponsor and their members.
- Currently available pharmacy cost models to forecast future drug expenditures include Medicaid CDPS pharmacy model, Medicare RxHCC model and others.
- This analysis is to explore an alternative model with pharmacy data only.

Objective

- To develop a new economic model to use patients' prior information to predict future pharmacy cost.

Methods

- This forecast analysis was based on a sample of 622,199 distinct members and their paid pharmacy claims during the 2017, 2018 and 2019 years who were enrolled in an employer sponsored pharmacy benefit plans.
- To be included in the eligible sample, members must have been continuously enrolled in the employer client sponsored pharmacy coverage plan for a minimum of two consecutive years or more.
- Age, gender and 57 drug therapeutic condition groupings follows the framework from CDPS pharmacy model.
- Pharmacy cost was normalized on a per member per month (PMPM) basis.
- In addition to age, gender and drug therapeutic condition variables, brand drug indicator, specialty drug indicator, previous year member specific PMPM were included in a one year shifted model (Table 1).
- The data was then randomly split into training, validation and testing datasets by 2:1:1 ratio.
- The employer clients in the testing dataset were mutually exclusive from those in training and validation datasets.
- Data was processed and analyzed by Netezza SQL and R programming.

Table 1: Formula for regression model

PMPM in 2019	Age *gender+ MRX Conditions + Brand Indicator + Specialty Indicator + PMPM in 2018
PMPM in 2018	Age *gender+ MRX Conditions + Brand Indicator + Specialty Indicator + PMPM in 2017

Addition of three important RX specific predictors **enhances the predictive model performance** to forecast member-centered future pharmacy cost.

Results

- Generalized linear regression model using R package was built from three different predictor models for the training, testing and validation datasets:
  - Model 1 – Demographic Only
  - Model 2 – Model without Pharmacy Spend (PMPM)
  - Model 3 – Model with Pharmacy Spend (PMPM)
- Their performance were summarized in Table 2 "Performance comparison for forecasting models".
- Model performance was assessed using distribution plots to compare predicted and observed values for both the training, testing and validation dataset (Figures 1).
- The current MRX model with input PMPM shows that the training dataset with average adjusted R2= 0.679.
- The validation datasets were to forecast future pharmacy expenditures with a comparable adjusted R2= 0.681.
- Independently, the PMPM drug cost from the test dataset provided an unbiased evaluation of model fit with an average adjusted R2= 0.637 with the inclusion of prior year pharmacy cost; adjusted R2= 0.32 without prior year pharmacy cost.

Figure 1: Predicted & observed PMPM from three datasets

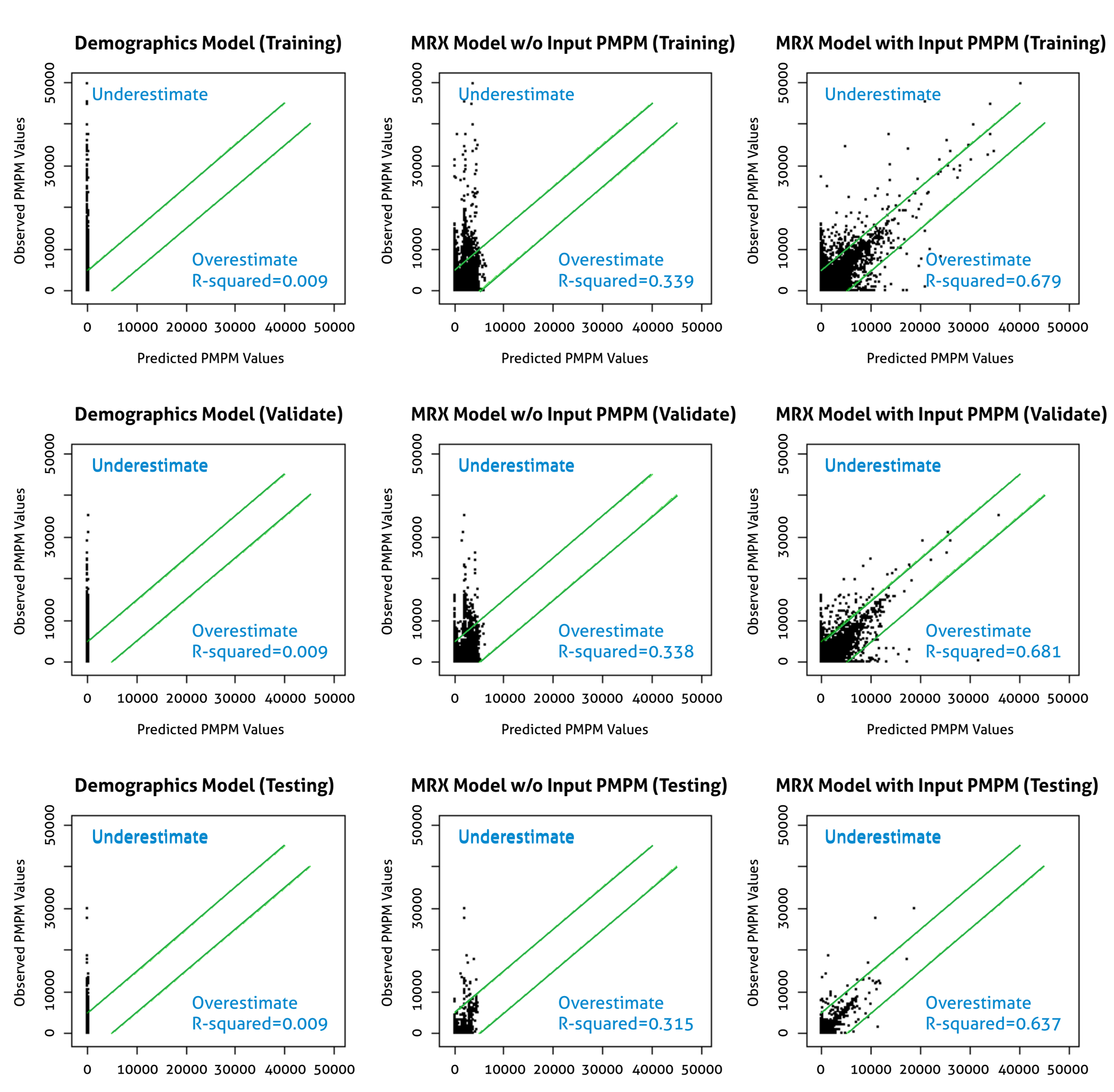

Table 2: Performance comparison for forecasting models

Model Type	Demographics only	Model w/o Last PMPM	Model with Last PMPM
Training Dataset Size	413,122	413,122	413,122
Training Model R^2	0.9%	33.9%	67.9%
Validation Dataset Size	222,636	222,636	222,636
Validation Model R^2	0.9%	33.8%	68.1%
Testing Dataset Size	228,866	228,866	228,866
Testing Model R^2	0.9%	31.5%	63.7%

Discussion

- The model with age and gender demographics information presents very minimal forecasting power. The model with Pharmacy-Based medical diagnoses was built for Medicaid population by Gilmer. The additional pharmacy claims information, specifically brand and specialty information is important to contribute to medication pricing. Due to continuity of treating chronic disease, the medication cost for two consecutive years are highly correlated. The current model to forecast commercial pharmacy cost has included those additional contributing factors.

Limitations

- Although data were randomly splitted 30 times, the result may still be skewed. Further research may be needed for general application.

Conclusion

- The developed models can forecast commercial pharmacy cost with enhanced predictive performance for members with or without prior year pharmacy cost, and across all the disease conditions.

References

- Gilmer T, Kronick R, Fishman P, Theodore, G. The Medicaid Rx Model: Pharmacy-Based Risk Adjustment for Public Programs. Medical Care. 2001; 39(11):1188-1202.
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