MILLIMAN WHITE PAPER

Milliman Advanced Risk Adjusters™ A better choice for Medicaid population health

A comparison of risk adjustment models on Medicaid data

Shannon Currier
Erica Rode, PhD, FSA, MAAA

Milliman

Managed care organizations that enroll and care for Medicaid populations require highly reliable risk adjustment and predictive modeling tools for population health assessments. While most Medicaid payment systems rely on the Chronic Illness and Disability Payment System risk models, these tools are not ideal for population health, assessing the risk of provider panels, or shared savings arrangements—because they were not primarily designed for those applications.

We analyzed the relative predictive power of two risk adjustment models on a Medicaid population: (1) the Chronic Illness and Disability Payment System (CDPS), and (2) Milliman Advanced Risk Adjusters™ (MARA). In general, across a wide variety of models, metrics, and Medicaid eligibility types, we found that in the great majority of cases MARA performed significantly better than CDPS at predicting the relative healthcare costs of individuals.

CDPS is a suite of risk adjustment models that were developed specifically for a Medicaid population and are used by several states to risk adjust Medicaid managed care organization (MCO) capitation rates. MARA includes models developed using commercial health plan data and Medicare data, but currently has not been specifically calibrated on a Medicaid population. However, a number of MARA clients have successfully used MARA scores in applications involving Medicaid enrollees. In 2016, the Society of Actuaries published a study that compared the predictive accuracy of various risk adjusters, including both MARA v3, which was the current version in the market at that time, and CDPS. In that study MARA generally had higher predictive accuracy than CDPS across the metrics examined. However, that study used data from a commercially insured population, not a Medicaid population. Since that report, a significant update to MARA (v4) has been released. MARA v4 includes two suites of models: the XPLN models featuring regularized regression, and the OPTml models featuring leading edge machine learning algorithms. In this study, we applied the current MARA v4 models and the CDPS models to Medicaid data to compare their predictive performance.

Models and Data Used

For our analysis, we used a large sample of Medicaid MCO data, which included pharmacy and medical claims, from an internal research database for calendar years 2013, 2014, and 2015. Our intent was to compare the predictive capabilities of MARA and CDPS on a Medicaid population (rather than a commercially insured population). MARA and CDPS both include several types of models based on the type of inputs available and the time period of the projection. MARA v4.1.2 CxXPLN and CxOPTml models were run on the pharmacy and diagnosis data, and these were compared to the combined Chronic Illness and Pharmacy Payment System (CDPS + Rx) models.

Both CDPS and MARA models offer concurrent and prospective versions. The concurrent version predicts relative costs over the same time period in which claims are analyzed. The prospective version predicts costs in the 12-month period immediately following the period in which claims are analyzed. We utilized both concurrent and prospective versions of each model to analyze a total of six models. Results are summarized separately for each year of data and for several different subpopulations.

Three years of Medicaid eligibility, claim, and pharmacy data were included in this study, incurred in calendar years 2013 to 2015. Concurrent risk scores were calculated for the 2013, 2014, and 2015 data, and prospective scores were calculated from the 2013 and 2014 data to project costs in 2014 and 2015, respectively. The year shown in each table is the year of data used to calculate the scores.

Members from the Children's Health Insurance Program (CHIP), Medicaid Disabled, Medicaid Dual Eligible, Medicaid Expansion, and Medicaid Low-Income eligibility types were included in the study. We excluded members classified as Medicaid Restricted Benefits. Medicaid Restricted Benefits members do not have comprehensive medical benefits, so we were not certain that either risk adjuster was appropriate for modeling their costs. Results for all CDPS and MARA models were consistently much poorer on this cohort than for all other eligibility types. Figure 1 shows the counts of members within each eligibility type for each year that was included in the study.

FIGURE 1: COUNTS OF MEMBERS BY MEDICAID ELIGIBILITY BY YEAR

Eligibility Type	2013	2014	2015
Children's Health Insurance Program	262,561	219,602	201,061
Disabled	328,005	356,204	343,507
Dual-Eligible	106,256	231,873	331,079
Medicaid Expansion	N/A	367,035	587,368
Low-Income	3,024,134	3,592,104	3,896,193
Total	3,720,959	4,766,818	5,359,208

Results

Results were measured by comparing the actual relative allowed claim cost per member per month (PMPM) for each member to the risk score produced by each model. We measured predictive accuracy using several common performance metrics. We have highlighted a few key metrics here, with more detail provided in the figures at the end of the report.

- After considering the population as a whole, MARA models had higher R^2 and lower mean absolute prediction error (MAPE) than CDPS + Rx for every model tested, both of which were indicative of better predictive accuracy. For example, the overall R^2 values for the concurrent MARA CxXPLN and CxOPTml models were more than double the R^2 for CDPS + Rx in all three years. For the prospective version of those models, the overall R^2 values of the MARA models were more than triple that of the CDPS + Rx model.
- For all included Medicaid eligibility types, MARA had a higher R^2 and lower MAPE than CDPS in each year. In particular, for both prospective and concurrent models, the R^2 values for the MARA CxXPLN and CxOPTml models were at least 120% to 150% higher than the CDPS + Rx models for the Medicaid Low-Income population, which comprised over 70% of the membership in the study.
- MARA showed materially better ability to identify high-cost members concurrently and prospectively, as measured by the positive predictive value (PPV) and area under the curve (AUC) metrics. This was particularly pronounced for members in the top 1% of allowed costs. For example, the PPVs of concurrent and prospective MARA models were at least 14 percentage points higher than the corresponding CDPS + Rx model for members in the top 1% of costs.

Higher R^2 values indicate that MARA is successfully explaining more of the observed variance in individual claim costs, while lower MAPE values indicate that on an absolute basis MARA's predictions have smaller errors on average across the populations.

The graphs below illustrate the performance of these models on the population as a whole. Performance was measured by predicting 2015 costs using 2015 claims and 2014 claims for the concurrent and prospective models, respectively.

FIGURE 2: OVERALL R^2 FOR CONCURRENT MODELS

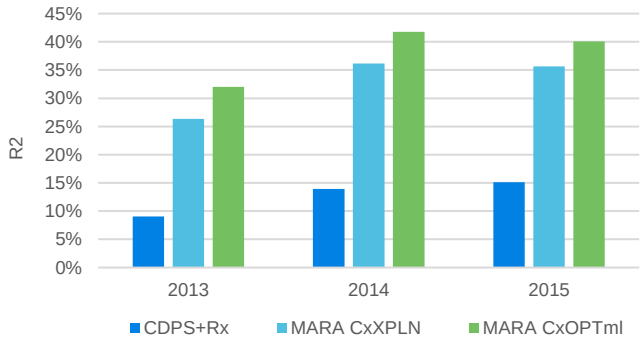


FIGURE 3: OVERALL R^2 FOR PROSPECTIVE MODELS

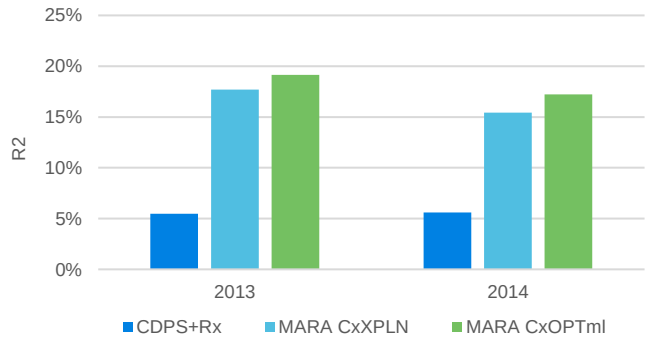


FIGURE 4: OVERALL MAPE FOR CONCURRENT MODELS

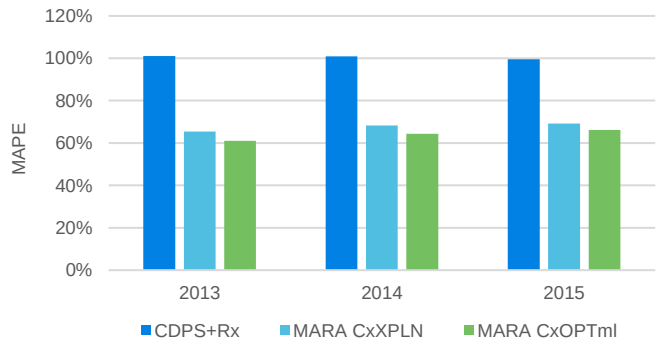


FIGURE 5: OVERALL MAPE FOR PROSPECTIVE MODELS

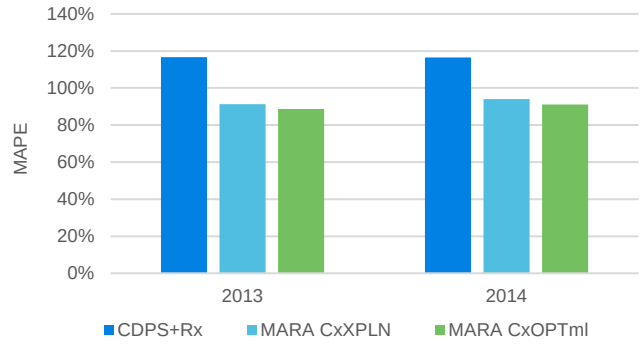


FIGURE 6: PPV BY COST STRATUM CONCURRENT DIAGNOSIS AND PHARMACY MODELS

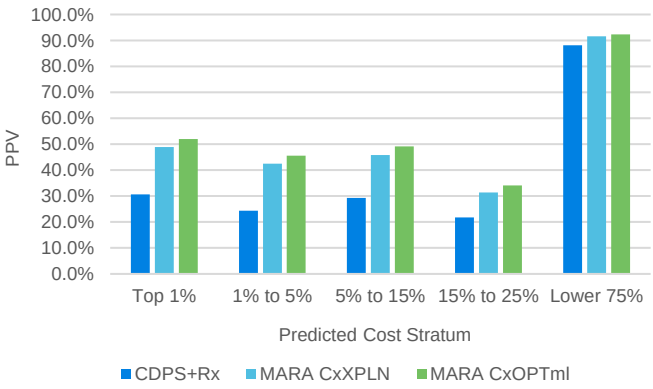


FIGURE 7: PPV BY COST STRATUM PROSPECTIVE DIAGNOSIS AND PHARMACY MODELS

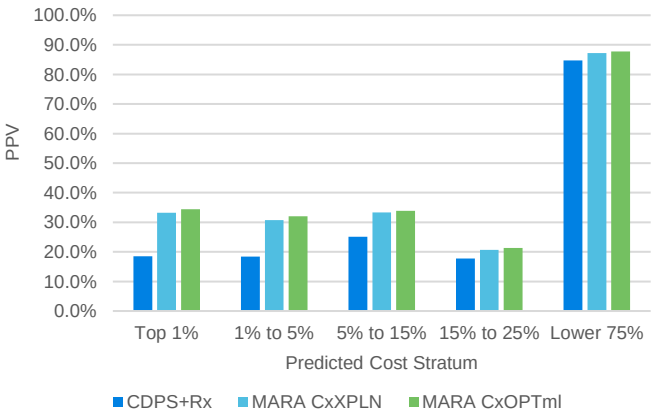


FIGURE 8: ROC CURVES FOR CLASSIFYING TOP 1% OF HIGH-COST CONCURRENT DIAGNOSIS AND PHARMACY MODELS

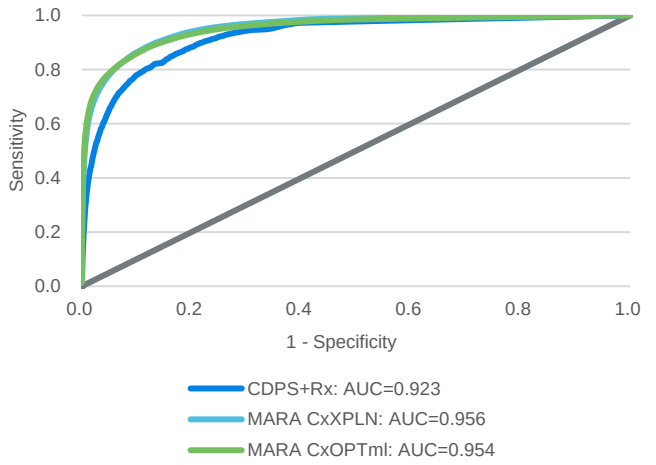
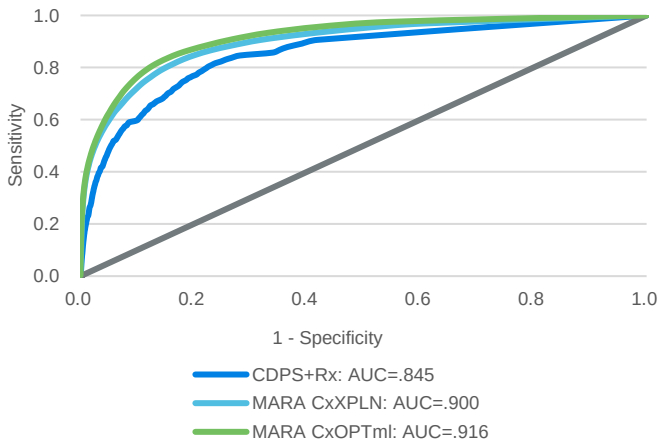


FIGURE 9: ROC CURVES FOR CLASSIFYING TOP 1% OF HIGH-COST PROSPECTIVE DIAGNOSIS AND PHARMACY MODELS



Caveats and Limitations

Milliman's work may not be provided to third parties without Milliman's prior written consent. Milliman does not intend to benefit any third-party recipient of its work product, even if Milliman consents to the release of its work product to such third party.

We relied on the data provided by several health plans through an internal Milliman database for results shown in this paper. We have not audited or verified this data and other information. If the underlying data or information is inaccurate or incomplete, the results of our analysis may likewise be inaccurate or incomplete. In that event, the results of our analysis may not be suitable for the intended purpose.

We performed a limited review of the data used directly in our analysis for reasonableness and consistency and have not found material defects in the data. If there are material defects in the data, it is possible that they would be uncovered by a detailed, systematic review and comparison of the data to search for data values that are questionable or for relationships that are materially inconsistent. Such a review was beyond the scope of our assignment.

The materials in this paper represent the opinion of the authors and are not representative of the views of Milliman, Inc. Milliman does not certify the information, nor does it guarantee the accuracy and completeness of such information. Use of such information is voluntary and should not be relied upon unless an independent review of its accuracy and completeness has been performed.

Milliman

Milliman is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in life insurance and financial services, property & casualty insurance, healthcare, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe.

milliman.com

For more details and a demonstration of MARA:
Steve McLane
steve.mclane@milliman.com

CONTACT the Authors:

Shannon Currier
shannon.currier@milliman.com

Erica Rode
erica.rode@milliman.com

© 2019 Milliman, Inc. All Rights Reserved. The materials in this document represent the opinion of the authors and are not representative of the views of Milliman, Inc. Milliman does not certify the information, nor does it guarantee the accuracy and completeness of such information. Use of such information is voluntary and should not be relied upon unless an independent review of its accuracy and completeness has been performed. Materials may not be reproduced without the express consent of Milliman.