Improving Medicare Advantage (MA) risk adjustment by limiting the influence of outlier predictions

Andy Johnson and Dan Zabinski
October 8, 2021
Medicare payments to MA plans are risk adjusted

- Medicare pays MA plans a capitated rate
  - Base payment amount \( \times \) beneficiary-specific risk score
- Risk scores adjust payment
  - Increase payment for beneficiaries expected to be more costly
  - Decrease payment for beneficiaries expected to be less costly
- Risk scores are based on
  - Demographic characteristics
  - Prior year diagnoses grouped into hierarchical condition categories (HCCs)
Model estimation determines size of coefficients (representing associated costs)

- Each demographic and HCC component has a coefficient that represents the expected cost associated with that component
  - A risk score is the sum of the relevant coefficients for a beneficiary
- Model estimation: A regression distributes the medical costs for a beneficiary to the coefficients relevant for the beneficiary
  - Coefficients are estimated using FFS data and reflect the average FFS cost associated with the component
- Risk scores are usually expressed as an index: sum of coefficient costs divided by the average FFS spending
  - In this presentation, coefficients are expressed in dollars
### Example calculation of predicted cost, risk score

<table>
<thead>
<tr>
<th>Model Component</th>
<th>Dollar coefficient</th>
<th>Score coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>74-year-old female, community-dwelling, without Medicaid benefits</td>
<td>$3,579</td>
<td>0.338</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>$4,415</td>
<td>0.417</td>
</tr>
<tr>
<td>Diabetes with chronic complications</td>
<td>$3,229</td>
<td>0.305</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>$3,134</td>
<td>0.296</td>
</tr>
<tr>
<td><strong>Predicted Cost</strong></td>
<td><strong>$14,357</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Risk Score</strong></td>
<td></td>
<td><strong>1.356</strong></td>
</tr>
</tbody>
</table>

- Score coefficient is equal to the dollar coefficient divided by the average annual FFS spending for non-ESRD beneficiaries, which was about $10,588 in 2019.
Risk adjustment strives to predict costs accurately on average for a group of people with similar attributes:

- Demographic characteristics and HCCs in the model have been selected for their ability to predict medical costs.
- The majority of medical costs are not predictable by commonly observed information, leaving unexplained cost variation.

More accurate risk adjustment:

- Improves the accuracy of payment to MA plans,
- Increases payment equity among plans, and
- Counters plan incentives to attract/retain beneficiaries that contribute to profits and avoid beneficiaries that contribute to losses.
Limiting the influence of outliers

- Since 2007, CMS-HCC model has been improved several times (e.g., adding variables, stratifying populations)
- Reinsurance and repayments are common in health insurance markets, but are not possible in MA due to insufficient cost data
- We evaluate a potential improvement to the model that limits the influence of outliers when estimating model coefficients
  - Method developed by McGuire, Schillo, and van Kleef
  - Simulates reinsurance and repayments in model estimation
  - Model accuracy is evaluated overall (using R² and Cummings Prediction measures) and for certain groups of beneficiaries (predictive ratios)

Steps to limit outlier predictions

1. Estimate model coefficients using current CMS-HCC model
2. Predict costs for each beneficiary using coefficients from (1) and calculate *prediction error = predicted cost – actual cost*
3. Apply loss limit to individuals with most underpredicted cost
   - Reduce actual cost data to satisfy loss limit (simulating reinsurance)
4. Apply gain limit to individuals with most overpredicted cost
   - Increase actual cost data to satisfy gain limit (simulating repayments)
5. Use the new data set with redistributed FFS costs to re-estimate CMS-HCC model coefficients to be used for payment
Identifying loss limit and gain limit

- Estimated standard CMS–HCC model using sample of 10.2 million FFS beneficiaries
- Used estimated model to calculate predicted costs and prediction errors (underpredictions and overpredictions)
- Used prediction errors to determine loss and gain limits; set these limits so that
  - Decrease in actual costs by simulated reinsurance is 2 percent of total costs
  - Increase in actual costs by simulated repayment is 2 percent of total costs
- Result: Loss limit = $106,500; Gain limit = $25,300
Limiting effects of outliers on model performance

- Used the loss and gain limits to adjust actual costs for outliers
  - Trimmed costs for underpredictions above loss limit
  - Augmented costs for overpredictions above gain limit
  - Decrease in actual costs offsets increase in actual costs, so the modification to the model is revenue neutral
- Used adjusted costs to re-estimate model (modified model)
Evaluating the performance of standard and modified models

- $R^2$: Indicates how well beneficiaries’ costs predicted by the model match their actual costs
  - Between 0 and 1; closer to 1.0 is better
  - Outliers reduce model’s accuracy resulting in lower $R^2$

- Predictive ratios: Indicates how well model predicts costs for specific group with same health characteristic (condition, age)
  - $PR = (\text{Predicted costs for group}) / (\text{Actual costs for group})$
  - $PR < 1.0$ indicates model predicts costs below actual costs for the group (underprediction)
  - $PR > 1.0$ indicates model predicts costs above actual costs for the group (overprediction)
Limiting outliers improves how well predicted costs fit actual costs

- $R^2$: 0.13 under standard model; 0.30 under modified model
  - Modified model explains 127 percent more of the variation in costs (consistent with McGuire et al.)
  - In contrast, changes that CMS has made to CMS–HCC model since 2007 increased $R^2$ from 0.11 to 0.13

- Improved predictive accuracy: Less incentive for plans to use costs to identify favorable risks

Data preliminary and subject to change
Limiting outliers improves predictions for beneficiaries with largest prediction errors

<table>
<thead>
<tr>
<th>Prediction error</th>
<th>PR from Standard model</th>
<th>PR from Modified model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% largest underprediction</td>
<td>0.13</td>
<td>0.26</td>
</tr>
<tr>
<td>1% largest overprediction</td>
<td>6.5</td>
<td>4.6</td>
</tr>
<tr>
<td>All beneficiaries</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

By predicting costs more accurately for the largest underpredictions and overpredictions, plans are less likely to experience substantial financial gains or losses.

Note: PR (predictive ratio). PRs are aggregate predicted costs for a group divided aggregate actual costs for a group.

Data preliminary and subject to change
Conclusions

- Limiting the influence of outliers would improve how well predicted costs match actual costs; less incentive to use costs to identify favorable risks
- Extent of substantial underpredictions and overpredictions would be reduced; plans less at risk for substantial losses
Discussion

- Next steps:
  - Commissioner questions about method and content
  - Address Commissioner feedback and continue analysis for future presentations and reports
- Additional risk adjustment issues or ideas for improving risk adjustment in the future