CLOSING THE FINANCIAL GAP IN COLOMBIA’S HEALTH SECTOR.

New methodology for calculating UPC.

ESdRAS Project.
About the speakers

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- Adjunct Professor, Dept. of Statistics & Applied Probability, University of California Santa Barbara.
- B.Phil (Balliol College, Oxford) PhD (Heriot-Watt University, Edinburgh)
- Health Actuary (40 years)/Consulting Actuary (30 years)
- Author, “Healthcare Risk Adjustment and Predictive Modeling” (2nd ed.) (Actex Publications) and “Managing and Evaluating Healthcare Intervention Programs” (2nd ed.) (Actex Publications)
- President, Santa Barbara Actuaries Inc. and Nvoyance LLC.

Juan Diego Mejia Becerra MS

- PhD candidate in the Dept. of Statistics & Applied Probability at the University of California Santa Barbara and an intern at Santa Barbara Actuaries Inc.
- Masters degree from National University, Colombia.
• Context.

• Problem Description.

• Contributions.
• Unitary Presidential Constitutional Republic.
• Population: 50M.
• GDP: $828B (31\textsuperscript{st}, PPP), $343 (38\textsuperscript{th}, Nominal),
• High Gini .
• High HDI.
• Member of: UN, WTO, OECD, OAS, Andean Community.

• Healthcare is a right.
• Two regimes: Contributory/Subsidized.
• All affiliates have a choice of insurer (EPS).
• Formal employees contribute x\% of pay.
ESdRAS Project | Problem Description

SGSSS (97.01%)
- Contributory (44.9%).
- Subsidized (47.7%).
- Other Regimes (4.41%).

Publicly Funded
- 68% of the healthcare expenditure.
- 4.9% GDP; uncontrolled budget.
ESdRAS Project | Problem Description

**Insurers**

- *Entidades Promotoras de Salud (EPSs).*
- Age/Sex and Territory Prospective Risk-adjustment System.

**Benefits Plan**

- PBS Services.
- Non-PBS Services (a.k.a. *Recobros*).
PBS Services Risk-adjustment System

### Age/Sex Differential (Cost Structure)

<table>
<thead>
<tr>
<th>Age/Sex</th>
<th>Differential (Cost Structure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>People less than one year</td>
<td>2.9679</td>
</tr>
<tr>
<td>People between 1 to 4 years old</td>
<td>0.9530</td>
</tr>
<tr>
<td>People between 5 to 14 years old</td>
<td>0.3329</td>
</tr>
<tr>
<td>Women between 15 to 18 years old</td>
<td>0.5014</td>
</tr>
<tr>
<td>Men between 15 to 18 years old</td>
<td>0.3173</td>
</tr>
<tr>
<td>Women between 19 to 44 years old</td>
<td>1.0475</td>
</tr>
<tr>
<td>Men between 19 to 44 years old</td>
<td>0.5646</td>
</tr>
<tr>
<td>People between 45 to 49 years old</td>
<td>1.0361</td>
</tr>
<tr>
<td>People between 50 to 54 years old</td>
<td>1.3215</td>
</tr>
<tr>
<td>People between 55 to 59 years old</td>
<td>1.6154</td>
</tr>
<tr>
<td>People between 60 to 64 years old</td>
<td>2.0790</td>
</tr>
<tr>
<td>People between 65 to 69 years old</td>
<td>2.5861</td>
</tr>
<tr>
<td>People between 70 to 74 years old</td>
<td>3.1033</td>
</tr>
<tr>
<td>People older than 75</td>
<td>3.8997</td>
</tr>
</tbody>
</table>

### Territory Type Differential (Cost Structure)

<table>
<thead>
<tr>
<th>Territory Type</th>
<th>Differential (Cost Structure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cities</td>
<td>1.0986</td>
</tr>
<tr>
<td>Areas difficult to access</td>
<td>1.1000</td>
</tr>
<tr>
<td>San Andrés, Providencia and Santa Catalina</td>
<td>1.3790</td>
</tr>
<tr>
<td>Other territories</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

**Base Rate 2021:**
- $938,826 COP/year (CR).
- $872,946 COP/year (SR).
ESdRAS Project | Problem Description

Non-PBS Distribution System

• Implemented in 2020.
• Involves IBNR Calculations.
• Distribution incorporates historical Patterns.

Specific payments

Add point here about how Colombian system is a mix of prospective risk-adjustment and retrospective specific reimbursements.
Further Adjustments

- Agreement 026 of 2011,
- High-Cost Fund (*Cuenta de Alto Costo*).
- Reimbursement for cost of certain conditions (HIV; some cancers; Hemophilia)
• Evaluate the current system (budget projections; payment accuracy).
• Recommendations for enhancement:
  • Budget projection methodology.
  • Condition-based risk adjustment system.
  • Quality management program.
  • Fraud and abuse monitoring system, and
  • Mitigation of insurers’ risk.
ESdRAS Project | Evaluation of the Current System

Loss Ratios Profile Plot

contributory

subsidized

enrollees

Year

2017 2018 2019

2017 2018 2019
<table>
<thead>
<tr>
<th>Regime</th>
<th>Year</th>
<th>N</th>
<th>Total Claims</th>
<th>Premium</th>
<th>Regime Loss Ratio</th>
<th>Mean Loss Ratio</th>
<th>S.D. Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>contributory</td>
<td>2017</td>
<td>14</td>
<td>$13,008,406,653.36</td>
<td>$16,822,806,639.80</td>
<td>77.33%</td>
<td>79.19%</td>
<td>13.12%</td>
</tr>
<tr>
<td>contributory</td>
<td>2018</td>
<td>15</td>
<td>$17,962,337,631.46</td>
<td>$21,598,226,971.63</td>
<td>83.17%</td>
<td>80.23%</td>
<td>18.33%</td>
</tr>
<tr>
<td>contributory</td>
<td>2019</td>
<td>16</td>
<td>$19,537,803,618.18</td>
<td>$23,317,712,631.74</td>
<td>83.79%</td>
<td>83.54%</td>
<td>14.98%</td>
</tr>
<tr>
<td>subsidized</td>
<td>2017</td>
<td>18</td>
<td>$ 7,866,965,239.70</td>
<td>$ 9,315,355,530.43</td>
<td>84.45%</td>
<td>86.87%</td>
<td>18.53%</td>
</tr>
<tr>
<td>subsidized</td>
<td>2018</td>
<td>19</td>
<td>$10,813,723,593.28</td>
<td>$12,562,188,859.00</td>
<td>86.08%</td>
<td>89.14%</td>
<td>18.00%</td>
</tr>
<tr>
<td>subsidized</td>
<td>2019</td>
<td>19</td>
<td>$12,957,637,135.77</td>
<td>$15,026,303,917.70</td>
<td>86.23%</td>
<td>88.49%</td>
<td>14.37%</td>
</tr>
</tbody>
</table>

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Steps Followed:

• Data Collection,
• Development of Dx Categories,
• Feature Extraction,
• Calibration of the Model, and
• Accuracy Testing.
Projected costs:
  • Regression model based on demographics and condition categories.

Condition Categories
  • SBA mapping of WHO ICD-10 codes.
<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M1</strong></td>
<td>Assigns a risk score of 1.0 to all the individuals.</td>
</tr>
<tr>
<td><strong>M2</strong></td>
<td>Current Colombian risk-adjustment system, adding recoveries (non-PBS) costs in an individual fashion.</td>
</tr>
<tr>
<td><strong>M3</strong></td>
<td>Current Colombian risk-adjustment system, adding the mean of the recoveries.</td>
</tr>
<tr>
<td><strong>M4</strong></td>
<td>Age, sex, territory model (see appendix D) calibrated on a 75% training sample of the full experience year dataset.</td>
</tr>
<tr>
<td><strong>M5</strong></td>
<td>Age, sex, territory, and the following conditions: Diabetes, hypertension, CKD, HIV, cancers, and coagulation and hemorrhagic disorders (see appendix E).</td>
</tr>
<tr>
<td><strong>M6</strong></td>
<td>Condition-based risk-adjustment model calibrated setting ( c ) at the 0.975 percentile.</td>
</tr>
<tr>
<td><strong>M7</strong></td>
<td>Developed condition-based risk-adjustment model presented in the previous subsections.</td>
</tr>
</tbody>
</table>
ESdRAS Project | Risk Adjustment Model

Split the full dataset into train and validation datasets.

Train dataset (75%)
- Calibration
- Estimation of \( \bar{C} \)
- Risk weights

Validation dataset (25%)
- Grouping
  - Age/sex
  - Territories
  - Condition Categories
  - Synthetic EPS

Comparison of predictive ratios
- Comparison of \( R^2 \), \( MAE \), tolerance curves, and area under the tolerance curve (AUC)
ESdRAS Project | Risk Adjustment Model

Tolerance Curves

Model
- M1
- M2
- M3
- M4
- M5
- M6
- M7

ECDF

Absolute Error (Risk Points)
### ESdRAS Project | Risk Adjustment Model

<table>
<thead>
<tr>
<th>Model</th>
<th>$R^2$</th>
<th>$MAE$</th>
<th>AUC (1.0 Cutoff)</th>
<th>AUC (3.0 Cutoff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>0.00%</td>
<td>1.38</td>
<td>19.51%</td>
<td>69.24%</td>
</tr>
<tr>
<td>M2</td>
<td>71.22%</td>
<td>1.01</td>
<td>45.93%</td>
<td>74.83%</td>
</tr>
<tr>
<td>M3</td>
<td>0.82%</td>
<td>1.38</td>
<td>32.06%</td>
<td>68.50%</td>
</tr>
<tr>
<td>M4</td>
<td>0.91%</td>
<td>1.22</td>
<td>44.19%</td>
<td>74.27%</td>
</tr>
<tr>
<td>M5</td>
<td>4.35%</td>
<td>1.19</td>
<td>45.34%</td>
<td>75.17%</td>
</tr>
<tr>
<td>M6</td>
<td>4.92%</td>
<td>1.09</td>
<td>43.28%</td>
<td>76.73%</td>
</tr>
<tr>
<td>M7</td>
<td>8.62%</td>
<td>1.02</td>
<td>60.03%</td>
<td>79.99%</td>
</tr>
</tbody>
</table>
ESdRAS Project | Budget Projection Methodology

2017
• Baseline
• $t - 4$

2019
• Experience
• $t - 2$

2021
• Application
• $t$
ESdRAS Project | Budget Projection Methodology

1) \( \hat{B}^{(reg)}_t = \hat{M}^{(reg)}_t \times \hat{C}^{(reg)}_t \),

2) \( \hat{C}^{(reg)}_t = \hat{C}^{(reg)}_{t-2} \times (1 + r^{(reg)}) \times (1 + f) \times (1 + \tau) \),

3) \( \hat{C}^{(reg)}_{t-2} = \hat{C}^{(PBS, reg)}_{t-2} + \hat{C}^{(No PBS)}_{t-2} \),

4) \( \hat{C}^{(PBS, reg)}_{t-2} = \frac{\text{Developed PBS Costs for the Experience Period}}{\hat{M}^{(reg)}_{t-2}} \),

5) \( \hat{C}^{(No PBS)}_{t-2} = \frac{\sum_{i \in GR} C_i \times P_i}{\hat{M}_{t-2}} \).
ESdRAS Project | Budget Projection Methodology

\[ \hat{B}^{(reg)}_t = \hat{M}_t \hat{M}(reg)_t \times \hat{C}^{(reg)}_t, \]
\[ \hat{C}(reg)_t = \hat{C}(reg)_{t-2} \times (1 + r^{(reg)}) \times (1 + f) \times (1 + \tau), \]

- **Estimated PMPM for the Experience Year**
- **Relative Increment in the Risk-Score**
- **Relative Increment in the frequency usage**
- **Estimated PMPM for the Application Period**
- **Economic Inflation Trending Factor**
\[ \hat{C}(\text{reg})_{t-2} = \hat{C}(\text{PBS, reg})_{t-2} + \hat{C}(\text{Non-PBS})_{t-2} \]
ESdRAS Project | Contributions

• Evaluation of the current system,

• Enhancement of the budget projection techniques accounting for both PBS and non-PBS services,

• Development of a condition based risk-adjustment system that enhances the accuracy of the existing one.
• Recommendations on a quality management program, fraud and abuse monitoring recommendations, and addressing EPSs risk.
Ajuste de Riesgos | Contactos

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