Cluster analysis of medication adherence in Pacific patients with high cardiovascular risk

Jim Warren, Yulong Gu, John Kennelly
EMR-enabled systematic estimation of medication adherence

- General Practice Electronic Medical Records (EMRs) indicate the availability of prescription medications to patients.
- *Medication possession ratio* (MPR) is a percentage of days covered with medication supply.
- An MPR<80% is commonly interpreted as indicating non-adherence.
The Caring Does Matter (CDM) intervention

- Targeted delivery
  - High cardiovascular disease risk (CVR≥10%, 5-year event risk)
  - Low MPR (<80%)
- Practice nurse-led structured chronic care model
  - setting up automatic reminders
  - undertaking patient contact, education and follow-up
• Demographics (gender, age, Pacific ethnicity subgroup, and quintile deprivation index)
• Baseline MPR and physiological measures (BP, lipids, HbA1c & BMI)
• Other risk factors at baseline (smoking status, CVR score and diabetes)
• $\Delta$MPR & $\Delta$Measures from baseline to 1-year follow-up
Research methods – clustering

- K-means clustering (3 tiers of variables)
  1. $\Delta$MPR
  2. $\Delta$MPR + demographics
  3. $\Delta$MPR + demographics + $\Delta$Measures + baseline measures + other risk factors

- CCC values for 2-6 clusters were examined to choose best # of clusters

- Wilcoxon test & chi-square to compare clustered patient groups (p<0.05)
Results – study participants

Total = 10,863 Pacific adults

- No CVR: 68%
- Low CVR: 13%
- High CVR: 19%
- High-CVR & low-MPR: 11%
- High-CVR & OK-MPR: 8%
Characteristics of high-CVR Pacific patients (n=1786) at baseline

- 45% women
- Mean age = 60 (SD=10.6)
- Mean BP = 132/80 (SD=14.9/10.2)
- Mean total-HDL ratio = 3.98 (SD=1.04)
- Mean HbA1c = 59 (SD=19.2)
- Mean BMI = 35 (SD=7.4)
Patients who failed to improve adherence during CDM had higher prevalence of diabetes.

But no significant diff. in demographics, ΔDBP, ΔHbA1c, Δtotal-HDL ratio, ΔBMI, baseline smoking status, or other baseline measures.
Tier 1 clusters (by $\Delta$MPR)
Tier 2 clustering

- By $\Delta$MPR + demographics
- No clear clusters are identified, with CCC<0 for each of the clustering approaches between 2 clusters to 6 clusters.
## Tier 3 clusters (by all variables)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient #</td>
<td>460</td>
<td>530</td>
<td>796</td>
</tr>
<tr>
<td>Mean ΔMPR - antiHT</td>
<td>2%</td>
<td>2%</td>
<td>-2%</td>
</tr>
<tr>
<td>Mean ΔSBP</td>
<td>-17.11</td>
<td>-2.16</td>
<td>8.7</td>
</tr>
<tr>
<td>Mean ΔDBP</td>
<td>-9.05</td>
<td>-2.09</td>
<td>3.75</td>
</tr>
<tr>
<td>Mean ΔHbA1c</td>
<td>-0.29</td>
<td>-15.03</td>
<td>1.38</td>
</tr>
<tr>
<td>Mean baseline (BL) SBP</td>
<td>148.89</td>
<td>130.58</td>
<td>123.81</td>
</tr>
<tr>
<td>Mean BL DBP</td>
<td>88.63</td>
<td>79.84</td>
<td>76.03</td>
</tr>
<tr>
<td>Mean BL Total-HDL ratio</td>
<td>3.93</td>
<td>4.21</td>
<td>3.93</td>
</tr>
<tr>
<td>Mean BL HbA1c</td>
<td>52.61</td>
<td>95.32</td>
<td>52.47</td>
</tr>
<tr>
<td>Mean BL BMI</td>
<td>34.51</td>
<td>36.47</td>
<td>35.06</td>
</tr>
<tr>
<td>Mean BL CVR</td>
<td>20.12</td>
<td>15.82</td>
<td>18.79</td>
</tr>
<tr>
<td>BL Diabetes %</td>
<td>52%</td>
<td>51%</td>
<td>61%</td>
</tr>
<tr>
<td>BL non-smoker %</td>
<td>57%</td>
<td>49%</td>
<td>57%</td>
</tr>
<tr>
<td>BL ex-smoker %</td>
<td>25%</td>
<td>23%</td>
<td>23%</td>
</tr>
<tr>
<td>BL smoker %</td>
<td>17%</td>
<td>27%</td>
<td>20%</td>
</tr>
<tr>
<td>Age</td>
<td>63.4</td>
<td>56.62</td>
<td>60.47</td>
</tr>
<tr>
<td>Quintile</td>
<td>3.89</td>
<td>4.14</td>
<td>3.9</td>
</tr>
</tbody>
</table>
• One cluster was characterized by higher but improving blood pressure
• Another cluster characterized by higher but improving HbA1c
• But no significant diff. among the 3 clusters in gender, Pacific islands, ΔMPR – cholesterol, ΔMPR – antidiabetics, Δtotal-HDL ratio, or ΔBMI.
Discussion

• Clustering of patients from programme data can guide further study to better understand and tailor interventions
  – Why didn’t the intervention work uniformly for all patients?

• In this case, no ‘smoking gun’ but some significantly different groups
  – Basis for patient focus groups based on cluster membership
  – May reveal themes that dictated their direction during the intervention period
Limitations

• May not be the ‘right’ data
  – We used what we had, but didn’t collect items like health beliefs and level of family/social support

• Can just be seeing ‘random’ variation
  – Those measured at a high point then tend to drift lower (‘regression to the mean’)
  – But there’s a difference between variation that’s unaccountable in the available model and that which is ‘truly’ random
    • E.g. you can get a high BP reading because you had a bad day, but deciding to skip heart medication for six months probably has a cause that is theoretically amenable to intervention
Conclusion

• Cluster analysis reveals statistically distinct patient groups
• EMR analysis can assist quality improvement initiatives
  – To better understand the characteristics of the population under intervention
  – To evaluate for whom the intervention was more or less effective
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Further info: jim@cs.auckland.ac.nz