Patterns of Tobacco Poly-Use in the Population Assessment of Tobacco and Health Study: A Multistate Markov Transition Analysis
Fatema Shafee Khorassani, Andrew F. Brouwer, Jana L. Hirschtick, Rafael Meza, Nancy L. Fleischer
University of Michigan School of Public Health, Ann Arbor, MI

Background

Goal:
Estimate transition rates between single, dual, and poly tobacco use categories over time to help identify areas for policy intervention.

Data:
Waves 1-4 of the Population Assessment of Tobacco and Health (PATH) study, 2013-2017

Methods

Transition rates between tobacco use categories in adults were estimated under a multistate Markov model framework accounting for complex survey weights. The use categories (defined as current everyday or someday use) were:

- Never use
- Non-current use (30 day abstinence)
- Single use of cigarettes, e-cigarettes, other combustibles, or smokeless tobacco (SLT)
- Dual use with cigarettes
- Poly-use with cigarettes
- Poly-use without cigarettes (including dual-use)

Instantaneous two-step transitions (e.g. from never use to dual use) were disallowed from the model, except for into non-current use. Included 24,336 adults who had data for at least two waves.

Key Findings

- Dual and poly-use categories are largely transient
- Single-use categories are more stable over time
- Transitions out of dual and poly-use categories that included cigarettes were most likely to cigarettes alone
- Transitions out of dual or poly-use without cigarettes were most likely to be sole non-cigarette product use or non-current use

Results

Transition State

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Poly-use without Cigarettes</th>
<th>Poly-use with Cigarettes</th>
<th>Cigarettes + Smokeless</th>
<th>Cigarettes + Combustible</th>
<th>Cigarettes + E-Cigarettes</th>
<th>Other Combustible</th>
<th>E-Cigarettes</th>
<th>Non-current Cigarettes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>19.2</td>
<td>2.7</td>
<td>10.0</td>
<td>16.4</td>
<td>8.6</td>
<td>2.9</td>
<td>2.7</td>
<td>0.9</td>
<td>7.5</td>
</tr>
<tr>
<td>Non-current</td>
<td>95.5</td>
<td>3.2</td>
<td>0.5</td>
<td>0.1</td>
<td>0.5</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Cigarettes</td>
<td>-</td>
<td>52.8</td>
<td>2.7</td>
<td>0.8</td>
<td>2.6</td>
<td>0.5</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>E-Cigarettes</td>
<td>-</td>
<td>8.2</td>
<td>76.8</td>
<td>0.7</td>
<td>0.4</td>
<td>&lt;0.1</td>
<td>6.5</td>
<td>5.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Other Combustible</td>
<td>-</td>
<td>26.8</td>
<td>7.1</td>
<td>65.7</td>
<td>1.7</td>
<td>0.7</td>
<td>10.7</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Smokeless Tobacco</td>
<td>-</td>
<td>37.9</td>
<td>2.4</td>
<td>46.6</td>
<td>0.8</td>
<td>0.3</td>
<td>4.0</td>
<td>&lt;0.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Cigarettes + E-Cigarettes</td>
<td>-</td>
<td>12.9</td>
<td>1.0</td>
<td>0.5</td>
<td>1.0</td>
<td>77.2</td>
<td>0.2</td>
<td>2.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Cigarettes + Combustible</td>
<td>-</td>
<td>5.9</td>
<td>46.2</td>
<td>7.6</td>
<td>0.3</td>
<td>0.1</td>
<td>29.7</td>
<td>3.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Cigarettes + Smokeless</td>
<td>-</td>
<td>7.6</td>
<td>37.7</td>
<td>0.4</td>
<td>3.7</td>
<td>0.1</td>
<td>3.0</td>
<td>35.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Poly-use with Cigarettes</td>
<td>-</td>
<td>4.2</td>
<td>25.9</td>
<td>0.4</td>
<td>0.3</td>
<td>9.7</td>
<td>3.7</td>
<td>3.9</td>
<td>12.0</td>
</tr>
<tr>
<td>Poly-use without Cigarettes</td>
<td>-</td>
<td>4.7</td>
<td>21.0</td>
<td>1.9</td>
<td>1.4</td>
<td>1.0</td>
<td>13.1</td>
<td>16.2</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Figure 1. Probability of transition from initial state (left) to transition state (top) within one wave, estimated from multistate Markov model

Results

- Sole cigarette or smokeless tobacco use was persistent with 76.8% and 77.2% users remaining users after one wave.
- Other single, dual, and poly-use states were more transient with 29.1% to 46.6% of users reporting the same use pattern after one wave.
- If single product users transitioned it was most likely to non-current use.
- If dual or poly-cigarette users transitioned it was most likely to sole cigarette use:
  - Cigarettes and e-cigarettes: 46.2% (95% CI 46-47); cigarette and other combustible: 37.7% (95% CI 37-39); cigarette and smokeless tobacco: 25.9% (95% CI 23-33); poly-user with cigarette: 21.0% (95% CI 17-25)
- If dual or poly-use without cigarette users transitioned it was most likely to:
  - Sole non-cigarette product (37.7% (95% CI 35-39)) or non-current (19.2% (95% CI 15-25)) use

Support is provided by grant U54CA229974 from the National Institutes of Health, National Cancer Institute and Food and Drug Administration (FDA).