Real-time stats for real-time problems

Informing daily practice via predictive analytics

Shannon M. Campbell, MPP
Senior Research & Evaluation Analyst

Mental Health & Addiction Services,
Multnomah County Health Department
Portland, Oregon

Contact information: shannon.campbell@multco.us
Background

- Topic of interest: acute care
  - Inpatient psychiatric hospitalizations, behavioral health-driven ER visits, psychiatric emergency services (Unity)
  - Want to reduce acute care utilization by engaging clients in different levels of care that sustainably address their needs
- We follow up on hospitalizations and ED visits, we craft models showing what factors may impact readmission, but:
  - Can we predict which of our members are most at risk of impending psychiatric crisis before they occur, so that we can intervene in a more timely manner?
Analysis

● Sample population:
  ○ Health Share members with 1+ year coverage and SPMI (severe and persistent mental illness), 1/1/15 to 6/30/17
  ○ Result: 13,158 clients; 11,222 acute care events

● Data sources:
  ○ Healthcare claims, call center records, enrollment data

● Variables:
  ○ Front-line staff input on contributing factors, indicators of impending crisis, common traits of high utilizers, etc.

● Statistical analysis
  ○ Logistic regression and Cox multi-failure survival analysis
Real-time stats // Informing practice via predictive analytics

Results

- Significant (non-demographic) variables:
  - No recent mental health outpatient history
  - Multiple SPMI-level diagnoses
  - History of substance use
  - Week with 2+ crisis line calls
  - History of homelessness/housing instability
  - Receiving SSI for disability
  - Healthcare encounters with respiratory issues as primary diagnosis
  - Healthcare encounters with pain issues as primary diagnosis
But what do we do with it?

- From complex statistical model to something actionable
- Step 1: score creation
  - Use weights from statistical analysis to develop a formula
    - E.g., substance use history increases risk by 4.5 times → does this person have a substance use history in the last 12 months, yes or no?
      - \[4.5 \times (1 \text{ or } 0) + \text{Weight}_2 \times (1 \text{ or } 0) + \text{Weight}_3 \times (1 \text{ or } 0)\ldots=\text{raw score}\]
  - Scale to easily understood range--e.g., 0 to 10
- Step 2: build the tool
  - Entire score can be automatically calculated from existing databases; stored procedure runs daily to update
  - Information available to staff via a Tableau dashboard
Acute Care Risk

**TOTAL CLIENTS:** 108,917

**AVG. RISK SCORE:** 2.50

**CLIENTS PER RISK SCORE**

- 0: 3,375
- 1: 3,641
- 2: 59,021
- 3: 24,317
- 4: 15,635
- 5: 1,789
- 6: 987
- 7: 100
- 8: 43
- 9: 9

**RISK GROUP**

- Low Risk: 66,037
- Medium-Low Risk: 39,952
- Medium-High Risk: 2,875
- High Risk: 52

**GENDER**

- Female: 58,539
- Male: 50,378

**AGE GROUP**

- 50+: 35,898
- 30 to 39: 25,571
- 40 to 49: 17,940
- 10 to 29: 29,508

**RACE**

- African-American: 9,460
- Asian: 7,876
- Caucasian: 45,399
- Hispanic: 4,960
- Native American: 1,006
- Other: 40,226
Acute Care Risk

Total Clients: 108,917
Average Risk Score: 2.50

Clients per Risk Score:
- 0: 3,375
- 1: 3,641
- 2: 59,021
- 3: 24,317
- 4: 15,635
- 5: 1,789
- 6: 987
- 7: 100
- 8: 43
- 9: 9

Risk Group:
- Low Risk: 66,037
- Medium-Low Risk: 39,952
- Medium-High Risk: 2,876
- High Risk: 52

Click here for client details

Gender:
- Female: 58,539
- Male: 50,378

Age Group:
- 50+: 35,898
- 30 to 39: 25,571
- 40 to 49: 17,940
- 10 to 29: 29,508

Race:
- African-American: 9,450
- Asian: 7,876
- Caucasian: 45,399
- Hispanic: 4,960
- Native American: 1,006
- Other: 40,226
## Client Details

<table>
<thead>
<tr>
<th>Policy ID</th>
<th>Full Name</th>
<th>Risk Score</th>
<th>Phone</th>
<th>Gender</th>
<th>Race</th>
<th>Age Group</th>
<th>Authorization Type</th>
<th>Vendor Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM982561</td>
<td>Jaime Lannister</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>ASIAN</td>
<td>30 to 39</td>
<td>GLOBAL - Level C Adult SPMI Global - Primary Auth</td>
<td>Cascade Behavioral Health Care</td>
</tr>
<tr>
<td>ANSK112081</td>
<td>Sansa Stark</td>
<td>9</td>
<td>481-516-2342</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>40 to 49</td>
<td>Outpatient SUD 1/1/17 - General Outpatient SUD - Adult - ADDICTION SERVICES 7/1/16</td>
<td>Cascade Behavioral Health Care</td>
</tr>
<tr>
<td>ATAN32850N</td>
<td>Natasha Romanoff</td>
<td>8</td>
<td>481-516-2342</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>30 to 39</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>AVOO546480</td>
<td>Davos Seaworth</td>
<td>8</td>
<td>503-867-5309</td>
<td>Male</td>
<td>NATIVE AMERICAN</td>
<td>50+</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>CHA42691AU</td>
<td>T'Challa T'Chaka</td>
<td>9</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>DAM610886G</td>
<td>Adam Young</td>
<td>8</td>
<td>481-516-2342</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>Outpatient MAT - MAT OTP - ADDICTION SERVICES 7/1/16</td>
<td>CRC Allied Health Services</td>
</tr>
<tr>
<td>DE18782EUL</td>
<td>Ed Mercer</td>
<td>8</td>
<td>481-516-2342</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>ELAR55538R</td>
<td>Fela O'Tarbean</td>
<td>9</td>
<td>503-867-5309</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>30 to 39</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>ELLS100028</td>
<td>Kelly Grayson</td>
<td>8</td>
<td>481-516-2342</td>
<td>Female</td>
<td>OTHER</td>
<td>30 to 39</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>EMUN109957</td>
<td>Remus Lupin</td>
<td>8</td>
<td>481-516-2342</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>ENDR57941R</td>
<td>Gendry Waters</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>18 to 29</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>EVEE76245E</td>
<td>Severus Snape</td>
<td>8</td>
<td>503-867-5309</td>
<td>Male</td>
<td>OTHER</td>
<td>18 to 29</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>HARL15668L</td>
<td>Charlie Weasley</td>
<td>8</td>
<td>503-867-5309</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>40 to 49</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>HARL88340L</td>
<td>Charlie Weasley</td>
<td>9</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>30 to 39</td>
<td>Outpatient SUD 1/1/17 - General Outpatient SUD - Adult - ADDIC...</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>HORS116312</td>
<td>Thor Odinson</td>
<td>8</td>
<td>481-516-2342</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>40 to 49</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>ILEA118790</td>
<td>Wiliem O'Colod</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>OTHER</td>
<td>50+</td>
<td>GLOBAL - Level C Adult SPMI Global - Primary Auth</td>
<td>Cascade Behavioral Health Care</td>
</tr>
<tr>
<td>IMN77013NR</td>
<td>Sim Dalonir</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>Outpatient MAT - MAT OTP - ADDICTION SERVICES 7/1/16</td>
<td>CRC Allied Health Services</td>
</tr>
<tr>
<td>IMN113376N</td>
<td>Sim Dalonir</td>
<td>8</td>
<td>503-867-5309</td>
<td>Male</td>
<td>OTHER</td>
<td>30 to 39</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>IRIK77569K</td>
<td>Sirius Black</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>40 to 49</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>KOY70337</td>
<td>Okoye Dora Milaje</td>
<td>8</td>
<td>503-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>NULL</td>
<td>NULL</td>
</tr>
<tr>
<td>LBU476939L</td>
<td>Albus Dumbledore</td>
<td>8</td>
<td>502-867-5309</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>50+</td>
<td>GLOBAL - Level C Adult Global - Primary Auth</td>
<td>CODA CD</td>
</tr>
<tr>
<td>LENL34232L</td>
<td>Olenna Tyrell</td>
<td>8</td>
<td>481-516-2342</td>
<td>Female</td>
<td>CAUSCIAN</td>
<td>18 to 29</td>
<td>Outpatient SUD 1/1/17 - General Outpatient SUD - Adult - ADDIC...</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>LENL343131</td>
<td>Olenna Tyrell</td>
<td>8</td>
<td>481-516-2342</td>
<td>Male</td>
<td>CAUSCIAN</td>
<td>18 to 29</td>
<td>NULL</td>
<td>NULL</td>
</tr>
</tbody>
</table>
Acute Care Risk

**Total Clients**: 765

**Avg. Risk Score**: 1.89

**Clients Per Risk Score**:
- 0: 98
- 1: 254
- 2: 196
- 3: 117
- 4: 68
- 5: 14
- 6: 17
- 7: 1

**Risk Group**:
- Low Risk
- Medium-Low Risk
- Medium-High Risk

**Gender**
- Male: 311

**Age Group**
- 50+ 331
- 18 to 29 147
- 40 to 49 141
- 30 to 39 146

**Race**
- African-American 756
- Asian 453
- Caucasian 4,457
- Hispanic 312
- Native American 133
- Other 2,076
# Client Details

<table>
<thead>
<tr>
<th>Policy ID</th>
<th>Full Name</th>
<th>Risk Score</th>
<th>Phone</th>
<th>Gender</th>
<th>Race</th>
<th>Age Group</th>
<th>Authorization Type</th>
<th>Vendor Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEO79730J</td>
<td>Theron Greyjoy</td>
<td>1</td>
<td>503-867-5309</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>ILEA119776</td>
<td>Wilm O'Neal</td>
<td>2</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>ILIW19592W</td>
<td>Filius Flitwick</td>
<td>1</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>30 to 39</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>ILLL18635L</td>
<td>Bill Weasley</td>
<td>1</td>
<td>481-516-2342</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>INEN31894N</td>
<td>Minerva McGonagall</td>
<td>2</td>
<td>481-516-2342</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>INNL22873L</td>
<td>Ginny Weasley</td>
<td>3</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>LENL34583L</td>
<td>Delenna Tyrrell</td>
<td>6</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>LEUC20632C</td>
<td>Fleur Delacour</td>
<td>1</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>LEUC63909C</td>
<td>Fleur Delacour</td>
<td>4</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>30 to 39</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>OJBE43909E</td>
<td>Tobias Beckett</td>
<td>3</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>ORAO267540</td>
<td>Jorsh Mormont</td>
<td>3</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>50+</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>RAXR18389R</td>
<td>Drax Destroyer</td>
<td>2</td>
<td>481-516-2342</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>30 to 39</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>RELD20743L</td>
<td>Fred Weasley</td>
<td>3</td>
<td>481-516-2342</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>RTHL11953L</td>
<td>Arthur Weasley</td>
<td>1</td>
<td>481-516-2342</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>TEVR78157R</td>
<td>Steve Rogers</td>
<td>1</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>UI733958L</td>
<td>Qui?ra Corelia</td>
<td>5</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>40 to 49</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Cascadia Behavioral Health</td>
</tr>
<tr>
<td>YBAI41920A</td>
<td>Sybil Trelawney</td>
<td>2</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult ICM Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>AIMI23569I</td>
<td>Jaime Lannister</td>
<td>1</td>
<td>481-516-2342</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>ANS96695S</td>
<td>Han Solo</td>
<td>1</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>EMUN73800N</td>
<td>Remus Lupin</td>
<td>1</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>HARL88374L</td>
<td>Charlie Weasley</td>
<td>2</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>LAIF52579F</td>
<td>Claire Finn</td>
<td>2</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>LAIF85595F</td>
<td>Claire Finn</td>
<td>3</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Central City Concern</td>
</tr>
<tr>
<td>NGES84436S</td>
<td>Angelina Johnson</td>
<td>1</td>
<td>503-867-5309</td>
<td>Male</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>ROOB59903B</td>
<td>Groot Treebeard</td>
<td>2</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
<tr>
<td>RUCE51740E</td>
<td>Bruce Wayne</td>
<td>0</td>
<td>503-867-5309</td>
<td>Female</td>
<td>AFRICAN-A</td>
<td>18 to 29</td>
<td>GLOBAL - Level D Adult TAY Global - Primary Auth</td>
<td>Lifeworks Northwest</td>
</tr>
</tbody>
</table>
Ethical considerations

- Responsibility to clearly communicate limits of analysis and principles of use
  - Only proactively offer help/services (never denying)
  - Respect for client autonomy
  - Not overriding clinical judgment
  - *Human behavior too nuanced, messy to reduce to single number; intended as an additional data point, not the definitive word on a person or their life*
Many thanks to the following:

- **Sivakrishna Yedlapelli** and **Shiva Sangireddy** (Decision Support), for SQL development and for Tableau design (respectively)—automating the tool and creating a clean and accessible final product;

- **Heath Barber**, **Lauren Castillo**, and **Jacob Mestman** (Decision Support), for project management and support, ensuring the tool’s sustainability;

- **Sarah Adelhart**, **Rochelle Pegel**, **David Sant** (Utilization Management), **Jessica Jacobsen**, **Rachel Phariss** (Adult Care Coordination), and **Leticia Sainz** (Crisis Line), for providing subject matter expertise on acute care utilization and critical feedback on this project;

- **Kelly Officer** (Oregon Criminal Justice Commission), for providing the CJC’s risk prediction methodology as the starting point for this project;

- **Devarshi Bajpai** (Medicaid Plan Manager), for brainstorming this project and championing the work.
“Real world” test

- If we used that scoring system on our entire population, how accurate would it be?
  - “Freeze” scores on specific date
  - Track actual events for next 30 days
  - Use score as main predictor

![Bar chart showing percent experiencing acute care event, by score range.]

- SPMI (original sample)
- All HSO (PIT: 5/15/18, viewed through 9/10/18, minus children)