Whatcom Alliance for Health Advancement

Intensive Case Management System:

Evaluation of health care outcomes
Background
**WAHA Intensive Case Management System (ICM)**

- ICM is a case management program coordinated by WAHA that aims to foster collaboration between health organizations, public agencies and funders to identify complex patients in our community and enroll them into a community-based case management system.

- ICM case managers work in a multi-disciplinary team across organizational boundaries to provide the appropriate level of support to complex patients.

- ICM case manager teams are comprised of mixed disciplines, such as housing case managers, nurses, social workers or mental health professionals, clients.

- Each team is oriented around the needs of a specific patient or client population based on a set of characteristics such as homeless, medically complex, frequently incarcerated, frequent users of EMS.

- For the purpose of this evaluation, each client received, on average, between 1-3 visits per month and 2-3 telephone calls.
Referred

Exclusion Criteria
(any one)
- Unwilling to sign ROI as determined by program director
- Unavailability of ICM case management staff

Eligible

No Enrollment

Completed Program

Attrition
- Violent behavior or threatens team
- Lost to follow-up/unable to contact
- Withdraw
- Death

Enrollment

Unable to Contact

End Service

August 2015

Source: WAHA
Methods overview

- **Study design**: retrospective cohort design with no comparison group

- **Intervention** is defined as ICM enrollment (yes/no)
  - Secondary exposure of interest is duration of program enrollment (days enrolled)

- **Outcomes**, comparing pre to post-enrollment period:
  - Change in ED visit rate
  - Change in hospitalization rate
  - Change in charges due to ED visits
  - Change in charges due to hospitalizations

- **Study subjects**: 130 individuals enrolled in ICM between January 13, 2014 and March 31, 2016, residing in Whatcom County, Washington
  - Per guidance of ICM program staff, inclusion criteria will be total enrollment in ICM for 90 or more days

- **Data source**: Individual-level, de-identified data on enrollee characteristics, program enrollment dates, and dates and charges of outcomes (ED visits, hospitalizations) was provided to the study team by WAHA
Problem:
- ICM enrollees are enrolled for varying amounts of time
- Concern that certain individual factors might be associated with both dropping out of the program AND our outcomes of interest

Solution:
- Include in our model each enrollee’s likelihood (i.e. propensity score) of dropping out of program in less than 180 days, given their age, sex, race, and ethnicity
- 180 days selected based on descriptive analysis of enrollment data
Results
Effect of ICM enrollment on ED visits and hospitalizations

<table>
<thead>
<tr>
<th>Outcome</th>
<th>% change comparing post to pre-intervention period</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED visit rate</td>
<td>-39%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospitalization rate</td>
<td>-64%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Charges billed for ED visits</td>
<td>-36%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Charges billed for hospitalizations</td>
<td>-62%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Sample interpretation

Adjusting for multiple enrollment periods & likelihood of having short program enrollment (<180 days), program enrollment was statistically significantly associated on average with a 38.8% reduction in the ED visit rate during the post-enrollment period (95% CI 21.2, 52.5, p-value <0.001).

Note: Program enrollment was not a significant predictor of having 0 visits/hospitalizations/charges for all 4 outcomes.
Sample interpretation

Given that total ED visits in pre period were ~408 per 200 days (the median enrollment period) for our cohort of 132 enrollees, a 38.8% reduction translates to a total of 158 prevented visits for a median enrollment period of 200 days. Or averting 1.2 ED visits per person during this time period.
Prevented healthcare costs due to ICM enrollment

**Sample interpretation**

Given that total ED charges in pre period were $1,048,801 per 200 days (median enrollment period) for our cohort of 132 enrollees, a 35.5% reduction translates to a total savings of $372,324 for a median enrollment period of 200 days. Or savings of $2,821 per person during this time period. Note that this is not net savings as cost of ICM program is not considered.
Strengths and limitations

Strengths

- Ability to look at both health care outcomes and associated costs
- Propensity scoring used to address lack of a comparison group
- Substantial ER and hospitalization reductions demonstrated

Limitations

- Outcome data limited to hospital environment (effects likely in other sectors)
- If ICM costs included, net costs/savings could be calculated
APPENDIX

FOR MORE INFORMATION, CONTACT:

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Although we originally planned to model this count data (visits, charges) using repeated measures Poisson regression, assessment of the outcome data revealed both overdispersion (greater than expected variability) and excess zeros.

Given that Poisson regression has been shown to be ineffective at modeling data with these distributional characteristics, we instead used zero-inflated negative binomial regression, clustering on client ID to model the pre/post enrollment change in our outcomes:

- Negative binomial regression is designed to address the problem of overdispersion.
- Zero-inflated approach essentially treats zero and non-zero counts as 2 separate distributions and models them separately.
- Clustering on client ID is essential because we are comparing individuals to themselves (and thus would see less variation than expected if not adjusted).

As mentioned earlier the regression models also included:

- Covariate for client-level propensity score for short enrollment (<180 days) conditional on age, sex, and race/ethnicity.
- Covariate indicator of having had multiple enrollment periods.

Model diagnostics:

- Likelihood ratio test of zero-inflated negative binomial model versus the zero-inflated Poisson model (4/4 models prefer negative binomial).
- Vuong test compares the zero-inflated model negative binomial with an ordinary negative binomial regression model (3/4 models prefer zero-inflated model).
Enrollment period number and duration

<table>
<thead>
<tr>
<th>Number of enrollment periods</th>
<th>Number of clients</th>
<th>% of clients</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>121</td>
<td>92%</td>
<td>215</td>
<td>195</td>
<td>90</td>
<td>472</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>7%</td>
<td>297</td>
<td>292</td>
<td>117</td>
<td>478</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2%</td>
<td>334</td>
<td>334</td>
<td>313</td>
<td>354</td>
</tr>
</tbody>
</table>

Note: Enrollees excluded if total enrollment duration was less than 90 days.

- Majority of enrollees only enrolled once during program

- Median enrollment duration = 199 days
  - As such, averted health care utilization and costs will be expressed as the amount averted per 200 days of program enrollment
### Missingness of baseline demographic and health factors

<table>
<thead>
<tr>
<th>Covariate</th>
<th>% missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0%</td>
</tr>
<tr>
<td>sex</td>
<td>0%</td>
</tr>
<tr>
<td>race</td>
<td>2%</td>
</tr>
<tr>
<td>ethnicity</td>
<td>3%</td>
</tr>
<tr>
<td>patient activation measure (PAM)</td>
<td>29%</td>
</tr>
<tr>
<td>patient health questionnaire (PHQ9)</td>
<td>29%</td>
</tr>
<tr>
<td>body mass index (BMI)</td>
<td>42%</td>
</tr>
<tr>
<td>behavioral health (BH) concern</td>
<td>16%</td>
</tr>
<tr>
<td>chemical dependency (CD) concern</td>
<td>24%</td>
</tr>
<tr>
<td>physical disability</td>
<td>71%</td>
</tr>
<tr>
<td>homeless</td>
<td>44%</td>
</tr>
<tr>
<td>incarceration count for prior 3 years</td>
<td>59%</td>
</tr>
</tbody>
</table>

### Association between enrollment duration and baseline demographic & health factors

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Regression coefficient*</th>
<th>p-value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.19</td>
<td>0.7</td>
</tr>
<tr>
<td>male sex</td>
<td>10.03</td>
<td>0.5</td>
</tr>
<tr>
<td>race</td>
<td>-</td>
<td>0.0003***</td>
</tr>
<tr>
<td>Hispanic ethnicity</td>
<td>30.28</td>
<td>0.2</td>
</tr>
<tr>
<td>PAM</td>
<td>0.76</td>
<td>0.2</td>
</tr>
<tr>
<td>PHQ9</td>
<td>-0.34</td>
<td>0.8</td>
</tr>
<tr>
<td>BMI</td>
<td>1.86</td>
<td>0.1</td>
</tr>
<tr>
<td>BH concern</td>
<td>-15.01</td>
<td>0.5</td>
</tr>
<tr>
<td>CD concern</td>
<td>29.62</td>
<td>0.2</td>
</tr>
<tr>
<td>disability</td>
<td>-60.68</td>
<td>0.09</td>
</tr>
<tr>
<td>homeless</td>
<td>-32.95</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Regression coefficient represents the change in enrollment duration (days) associated with a 1-unit change in each covariate. For example, men were on average enrolled for 10 days longer than women (not statistically significant).

**P-value <0.05 represents statistical significance.

***This represents a Wald test of equal enrollment duration across all 6 racial groups.