Addressing The Opioid Epidemic: Treatment Capacity Expansion To Reduce Care Disparities For Opioid Addiction Disorders

Background
- National opioid epidemic: 91 overdose deaths each day
- 80% of people with opioid abuse disorders do not get treatment
- National and state treatment capacity is well below demand
  - Massachusetts: treatment wait times range 2-24 weeks despite 161 treatment centers in state
- Treatment capacity needs to be strategically expanded to optimally meet demand

Objectives
- Develop a model to optimally allocate patients and locate new treatment facilities
- Simulate scenarios under expansion investments for 5 to 20 additional outpatient treatment centers in Massachusetts
- Evaluate treatment benefits, access delays, overdoses, and associated mortality

Optimization
- Maximizes patient access within 20 miles of their residence
- Optimizes location of user-defined number of new treatment facilities
- Allocates treatment-seeking drug abusers to outpatient facilities
- Distance matrix used to calculate patient travel
  - Mapped with ArcGIS
- Demand calculated using overdose and population data
- Uses ILOG IBM CPLEX Optimization software

Methods

<table>
<thead>
<tr>
<th>Model Inputs</th>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Digit Zip Codes</td>
<td>143</td>
<td>-</td>
</tr>
<tr>
<td>Treatment Demand</td>
<td>55,820</td>
<td>-</td>
</tr>
<tr>
<td>Existing Facilities</td>
<td>161</td>
<td>-</td>
</tr>
<tr>
<td>Total Capacity</td>
<td>50,232</td>
<td>-</td>
</tr>
<tr>
<td>Max Travel Distance</td>
<td>20 miles</td>
<td>-</td>
</tr>
<tr>
<td>Annual Treatment Dropout Rate</td>
<td>56%</td>
<td>42-70%</td>
</tr>
<tr>
<td>Treatment Queue Dropout Rate</td>
<td>54%</td>
<td>40.5-67.5%</td>
</tr>
<tr>
<td>Overdose while in Treatment Queue</td>
<td>13%</td>
<td>9.7-16.3%</td>
</tr>
<tr>
<td>Overdose Fatality</td>
<td>10%</td>
<td>7.5-12.5%</td>
</tr>
</tbody>
</table>

Simulation
- Utilizes results from optimization model to understand real-world effects on demand and capacity
- Measures:
  - Wait time
  - Patients successfully treated
  - Number of dropouts from treatment and queue
  - Overdoses and fatalities
- Simulates 2 years with 13 replications
- Built in Python programming language

Results

- Without adding new treatment facilities:
  - >7,000 patients cannot access care within 20 miles
  - Median wait time is 2-months, during which 2,389 patients overdose while waiting for treatment
- Adding facilities:
  - Increases number of patients completing treatment
  - Decreases overdose/death while waiting for treatment

<table>
<thead>
<tr>
<th>Expected Outcomes</th>
<th>New Facilities Added</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Unmet Demand</td>
<td>7,190</td>
</tr>
<tr>
<td>Patients Treated</td>
<td>37,034</td>
</tr>
<tr>
<td>Dropout of Queue</td>
<td>16,534</td>
</tr>
<tr>
<td>Overdoses Prevented</td>
<td>0</td>
</tr>
<tr>
<td>Deaths Prevented</td>
<td>0</td>
</tr>
<tr>
<td>Median Wait Time (Days)</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 2. Model Results by Number of New Facilities Added

With 20 Added Facilities:
- 98% of treatment-seekers within 20 miles of outpatient care
- Median wait time decreases by 18 days
- 50% decrease in dropouts from queue
- New facilities located in suburban or rural areas
- Average travel distance is 5.04 miles

Key Findings
- No new facilities opened in Boston: indicates need for treatment in rural areas
- Sensitivity analysis shows treatment dropout rate had greatest effect on number patients successfully treated

Conclusions
- Results are useful to policy makers improving access to treatment under constrained budgets
- Future work will incorporate treatment relapses, capacity pooling, and social distancing

Figure 1. Location of existing (red) and 20 new (blue) facilities