Who will show?

Predicting missed visits in the CFAR Network of Integrated Clinical Systems (CNICS) cohort of patients in HIV care in the United States

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Missed HIV Visits are Common

Indicators of HIV care attendance among 10,053 HIV-infected patients at 6 HIV clinics over 12 months, 2008-2009

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Percent of patients or appointments</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 no-show visit</td>
<td>67%</td>
</tr>
<tr>
<td>Missed visit proportion</td>
<td>31%</td>
</tr>
<tr>
<td>No 4-month constancy</td>
<td>49%</td>
</tr>
<tr>
<td>≥6 month gap between appointments</td>
<td>32%</td>
</tr>
<tr>
<td>Not retained by HRSA HAB measure (≥2 visits ≥90 days apart)</td>
<td>23%</td>
</tr>
</tbody>
</table>

Mugavero JAIDS 2012
Missed Visits Matter...

Association of missed visits with mortality

![Graph showing the association of missed visits with mortality. The graph plots the proportion surviving against years since the first visit, with two lines representing patients with no missed visits in the first year and those with at least 1 missed visit. The Logrank P value is 0.02. The table below shows the number of patients, deaths, and censored cases at different time points.]

<table>
<thead>
<tr>
<th>Time since first visit</th>
<th>No missed visits in first year</th>
<th>At least 1 missed visit in first year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>218</td>
<td>325</td>
</tr>
<tr>
<td>Died</td>
<td>5% (10)</td>
<td>10% (32)</td>
</tr>
<tr>
<td>Censored</td>
<td>95% (208)</td>
<td>90% (293)</td>
</tr>
</tbody>
</table>
... Even for patients meeting retention benchmarks

Association of missed visits with mortality among patients meeting HRSA HAB retention criterion

![Graph showing survival rates over years from ART start for different no-show categories: No-shows 0, 1-2, >2. Survival rates decrease with increasing no-shows. The log-rank test has a p-value < .0001.](image)

Mugavero
CID 2014
Research question

Can we predict who will no-show for his or her next appointment?

And proactively target resources?
Data source: CFAR Network of Integrated Clinical Systems (CNICS)
CNICS Data Elements

- Electronic Health Records data
  - Demographics
  - Appointment attendance
  - Labs
  - Medications
  - Diagnoses
- Patient-Reported Outcome data (~ every 6 months)
  - Depression, anxiety, substance use, alcohol use
  - ARV adherence
Sample

- All patients with ≥1 attended HIV medical appointment with PRO data between 2005-2014

- Included all visits with current PRO data (<6 months old)

- Separately considered patients in care at CNICS site <1 year vs. ≥1 year
Methods

• Unit of analysis: Each attended appointment
• Outcome: Whether next scheduled visit was attended or missed (after excluding bounced, canceled, and rescheduled visits)
• Fit predictive logistic regression models using predictors specified \textit{a priori}
• Used robust variance to account for multiple observations per patient
• Created risk scores from models’ predicted probabilities
• Compared model predictive power using area under the curve (AUC) and sensitivity and specificity at various cutpoints
## Potential predictors

<table>
<thead>
<tr>
<th>Demographic / Contextual</th>
<th>Clinical</th>
<th>Psychosocial (PROs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>CD4</td>
<td>Depression</td>
</tr>
<tr>
<td>Age</td>
<td>HIV RNA &lt; 75 c/mL</td>
<td>Anxiety</td>
</tr>
<tr>
<td>Gender</td>
<td>Time in care at CNICS site</td>
<td>Substance use</td>
</tr>
<tr>
<td>Race / Ethnicity</td>
<td>ARV status</td>
<td>Alcohol use</td>
</tr>
<tr>
<td></td>
<td>Past-year missed visit proportion*</td>
<td>ARV adherence</td>
</tr>
</tbody>
</table>

* Only for patients in care at CNICS site ≥1 year
<table>
<thead>
<tr>
<th>Sample</th>
<th>N</th>
<th>Mean (SD) or %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>11,552</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>40 (10)</td>
</tr>
<tr>
<td>Male gender</td>
<td>9,402</td>
<td>81%</td>
</tr>
<tr>
<td>Black non-Hispanic</td>
<td>4,315</td>
<td>38%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1,461</td>
<td>13%</td>
</tr>
<tr>
<td>Person-years</td>
<td>52,285</td>
<td>4.5 (4.1)</td>
</tr>
<tr>
<td>Appts with current PRO data</td>
<td>70,928</td>
<td>7.6 (7.2)</td>
</tr>
<tr>
<td>Next appointment missed</td>
<td>11,139</td>
<td>16%</td>
</tr>
<tr>
<td>Appt. in 1st year of CNICS care</td>
<td>12,694</td>
<td>18%</td>
</tr>
</tbody>
</table>
Results: Missed visits more likely if...

• Missed visits in past year
• Current drug use
• Younger age
• Black non-Hispanic
• Female
• Lower CD4, higher VL
• Not on ART, or on ART but nonadherent
• High depressive symptoms
• High panic symptoms

Weak or no association with:
• Calendar year
• Alcohol use
• Time in care at CNICS site
Past-year MVP as predictor of missing next visit
(For patients in care at CNICS site ≥1 year)

Sens = 74%
Spec = 55%

Sens = 50%
Spec = 79%

Sens = 13%
Spec = 96%

Missed visit proportion, past year

Proportion
Predictive power of past-year MVP
(For patients in care at CNICS site ≥1 year)

Patients in care >=1 yr: Predicting missed next appt

- MVP > 0%:
  - Sens = 74%
  - Spec = 55%

- MVP > 25%:
  - Sens = 50%
  - Spec = 79%

- MVP > 50%:
  - Sens = 13%
  - Spec = 96%

AUC = 0.68

Area under ROC curve = 0.6836
Predictive power of full predictive model
(For patients in care at CNICS site ≥1 year)

MVP only

Full model
Predictive power of model for patients in care <1 year

Sens = 69%
Spec = 50%
AUC = 0.64

Full model (no MVP)

AUC = 0.71

Full model (including MVP)

AUC = 0.64
Opportunity to target resources

6% of the clinic population has a 43% no-show risk and accounts for 15% of all no-shows → High-intensity intervention

49% of the clinic population has a 9% no-show risk and accounts for 26% of all no-shows → Standard care

44% of the clinic population has a 23% no-show risk and accounts for 59% of all no-shows → Low-intensity intervention

Past-year MVP 0%
Past-year MVP 1-50%
Past-year MVP 51-100%
Implications and Conclusions

• Characteristics measurable when a patient is in clinic can predict whether the patient will miss his or her next appointment
• Past missed visits are a strong predictor of future no-shows
• Demographic, clinical and psychosocial variables can modestly improve prediction of future no-shows
• Use of a multi-level risk score approach can focus increasing levels of resources on those at increasing risk of missed visits
• Opportunity to target resources to preempt missed visits and improve HIV care outcomes
Many thanks to...

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• CNICS participants

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