Predictors for longitudinal engagement and retention in care among women living with HIV in the US

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Goals of presentation

1. Introduction to a new statistical framework and methodology
2. Findings from application of the new method
Identify leaks in the cascade

FIGURE 1. Estimated percentage of persons living with HIV infection,* by outcome along the HIV care continuum — United States, 2011

Abbreviations: HIV = human immunodeficiency virus; ART = antiretroviral therapy.
* N = 1,201,100.

Known correlates of engagement in care

Mugavero et al. CID. 2013: Individual (intrapersonal), relationship (interpersonal), community, healthcare system, and healthcare policy factors that influence the processes of *engagement in care*.

- **Common approaches:**
  - Short term retention
  - Capture cross-sectional snapshot of engagement or retention: logistic regression
Challenges in modeling engagement and retention in care

Longitudinal patient behavior is complex
- Multiple states related to engagement in care: loss to follow up, mortality, transfer-out
- Progression not ‘linear’ but cyclic

Operationalizing retention aspects of care: state transitions

- Patient retention dynamics: transition from one state to another
  - transition from engaged to engaged: retention
  - transition from disengaged to engaged: re-entry into care
Illustration of SSM using data from a US cohort

- **CNICS**: The CFAR Network of Integrated Clinical Systems

- An integrated clinical database composed of EMR-based resources from 8 sites in the US (CWRU, Fenway, JHU, UAB, UCSD, UCSF, UNC, and UW)

- Eligibility: HIV infected patients who are engaged in CNICS-affiliated care

- Electronic health record
  - captures comprehensive clinical information
  - demographics, diagnoses, laboratory test, medication, health care utilization, vital status, patient reported outcomes, antiretroviral resistance, and biologic specimens data...
Operationalizing the retention aspect of care in context

- Use four (mutually exclusive) states to represent the retention aspects of care

![State Space Framework Diagram]

- Temporal trends and covariate effects associated with the cyclic processes of engagement and retention
Organizing data into states

(t=0)

(enrollment)
Organizing data into states

- $t=0$: (enrollment)
- $t=200$: Engaged
- $t=400$: Engaged
- $t=600$: Disengaged

State Space Framework

Introduction
The HIV Care Cascade
State Space Framework for Modeling of the Cascade
Analysis of women in CNICS
The HIV Care Cascade

State Space Framework for Modeling of the Cascade
Analysis of women in CNICS

ID: 1

- Enrollment date: Apr 9th 2010
- The second primary visit date: Feb 23rd 2011
- t=0: Engaged
- t=400: Disengaged
- t=600: Engaged
- t=200: Engaged
- t=800: Engaged
- t=1000: Engaged

ID: 2

- Enrollment date: June 3rd 2008
- t=0: Engaged
- t=200: Engaged
- t=400: Disengaged
- t=600: Engaged
- t=800: Disengaged
- t=1000: Disengaged
- t=1200: LFC

ID: 3

- Enrollment date: June 3rd 2008
- t=0: Engaged
- t=200: Engaged
- t=400: Engaged
- t=600: Deceased
Analysis of women in CNICS

- Data from 5,940 WLWH who engaged in and followed from 8 CNICS sites between 1996 and 2015

- Majority: African American (63%) and non-Hispanic (84%)

- Median age 39, CD4 357, and viral load 21,000

- Key variables:
  - CD4 count, viral load, ART status, OBGYN
  - age, race/ethnicity, AIDS, injection drug use (IDU), transgender
  - calendar year and site
Temporal trends

Retention curve

![Retention curve graph](image-url)
Temporal trends

Re-entry and lost from cohort (following disengagement)
### Covariate effects: transition from engaged

Effects of clinical characteristics: CD4 counts, viral load, and ART status (all time-varying), and OBGYN (time-fixed)

<table>
<thead>
<tr>
<th></th>
<th>Engaged</th>
<th>Disengaged</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition probability</td>
<td>.86</td>
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<td>.01</td>
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<tr>
<td>CD4 &lt; 250</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>CD4 250-500</td>
<td>—</td>
<td>0.87*</td>
<td>0.33*</td>
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<tr>
<td>CD4 ≥ 500</td>
<td>—</td>
<td>0.80*</td>
<td>0.15*</td>
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<tr>
<td>Viral load</td>
<td>—</td>
<td>1.24*</td>
<td>1.23*</td>
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<tr>
<td>On ART</td>
<td>—</td>
<td>0.85*</td>
<td>0.61*</td>
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<tr>
<td>AIDS</td>
<td>—</td>
<td>0.68*</td>
<td>3.19*</td>
</tr>
<tr>
<td>OBGYN</td>
<td>—</td>
<td>0.53*</td>
<td>0.46*</td>
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Covariate effects: transition from engaged

Effect of other risk factors: Age, IDU, and transgender (time-fixed)

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<tbody>
<tr>
<td>Caucasian</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AA</td>
<td>—</td>
<td>0.96</td>
<td>0.82</td>
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<tr>
<td>Others</td>
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<td>0.96</td>
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<tr>
<td>Hispanic</td>
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<td>0.73*</td>
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<tr>
<td>Age≥ 40</td>
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<td>0.72*</td>
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<tr>
<td>IDU</td>
<td>—</td>
<td>1.02</td>
<td>1.42*</td>
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## Covariate effects: transition from disengaged

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<td>0.97</td>
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Covariate effects: transition from disengaged

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Results summary

1. The first two years might be the optimal time to prevent future disengagement and ultimate loss.

2. Among those engaged:
   - Sicker patients who are not on ART and yet developed AIDS defining illness: more likely to disengage and die.
   - No racial disparity found in long-term engagement and retention behavior.
   - Younger non-Hispanic women are more likely to disengage.

3. Among those disengaged:
   - Patients with higher viral load who have yet developed AIDS: more likely to continue disengaged.
   - AA and Hispanics are less likely to be lost: might be due to limited care resources and awareness.

4. There was a site and temporal variations.
Conclusions

- Can inform the development of guidelines that are tailored to female patient characteristics in CNICS, customized to sub-populations at highest risk of falling out of care
- Develop risk score to flag patients at higher risk of falling out of care
- The first study to make full use of 20 years of cohort data from the HAART era
- Acknowledge the fact that engagement and retention in care is a cyclic process
- Opportunity: WIHS
Acknowledgment

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