BEYOND THE STATIC HIV CONTINUUM: CAPTURING THE DYNAMIC PROCESS OF RETENTION

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BACKGROUND

Studies examining engagement in HIV care often capture cross-sectional binary snapshots of individual patient status to estimate retention and identify predictors of attrition. This approach partially describes longitudinal engagement and retention in care in that it provides only a summary view, ignoring patterns of longitudinal patient care-seeking behaviors, including the cyclical nature of engagement, disengagement, and re-entry into care.

- **Objective:** We propose a state space representation to characterize the longitudinal process of engagement and retention in HIV care using data from the CFAR Network of Integrated Clinical Systems (CNICS), one of the most comprehensive multisite HIV clinical databases in the US.

METHODS

- Each phase in the HIV care cascade is viewed as a ***state***.

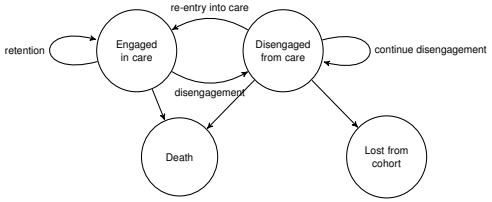


Figure 1. Graphical representation of retention aspects of care in the spanning of the HIV care continuum. Circles represent operational states that define the care retention. Arrows represent all possible (one-step) transitions within and between states and their practical meanings

- Multi-state models: parameterized by probability of transitioning from one state to another

$$\mathbf{S}_t = \text{state at time } t$$

$$\mathbf{pr}_{jkt} = pr\{S_t = k \mid S_{t-1} = j\}$$

- Example: **S**={1,2,3,4} = {Engaged in care, Disengagement from care, Lost from cohort (LCF), Death}
- p_{11t} : probability of transition from engaged to engaged (***retention***)
- p_{21t} : probability of ***re-entry*** into care after disengagement
- Effect of covariates on $\mathbf{pr}_{jkt}$ can be assessed by multinomial logistic regression:

$$\mathbf{logit}\{pr_{jkt}(X_t) / pr_{jJt}(X_t)\} = \beta_{jk}^T I\{S_{t-1}=j\}\, X_t \quad \text{----- (1)}$$

X_t = a collection of covariates (potentially time-varying)
J = reference state
β_{jk} = a log relative rate ratio

We set engaged in care (state=1) as the reference state as transition to engagement in care is a desirable transition.

DATA PREPARATION

- Set time grids at every 200 days: State membership was ascertained at equally spaced 6-month intervals to reflect the CNICS viral load monitoring guidelines, which recommend viral load monitoring twice a year at minimum, as viral load is often used as a proxy for care visit. We allowed extra two weeks to allow for scheduling variation.

- LFC: no clinical visit until database closure date (Dec, 31st, 2015) after more than one year of disengagement from care (i.e., no visit record available until database closure after two consecutive disengagements)

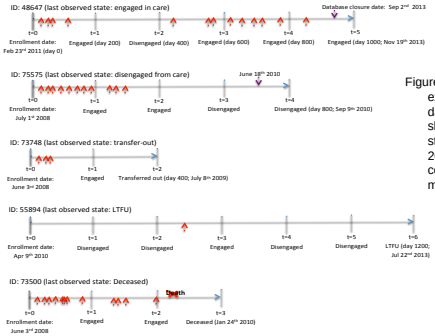


Figure 2. An illustrative example (not sample data from CNICS) to show how to ascertain state membership every 200 days that reflects a cohort patient monitoring guideline

RESULTS

Participants: 31,009 patients in HIV care from eight contributing sites (CWRU, Fenway, JHU, UAB, UCSD, UCSF, UNC, UW) who are engaged in CNICS affiliated care in modern HAART era (from January, 1996 through July, 2015).

CNICS cohort were 81% male, 11% Caucasian, and 39% African American. Risk factors for HIV acquisition were mostly MSM (51%) or heterosexual behaviors (30%). Median age at the first primary visit to a CNICS care was 39 years (IQR = 32 – 46). Median CD4 counts and $\log_{10}$ viral load were 348 (IQR: 155 – 556), and 4.46 (IQR: 3.66 - 5.06), respectively.

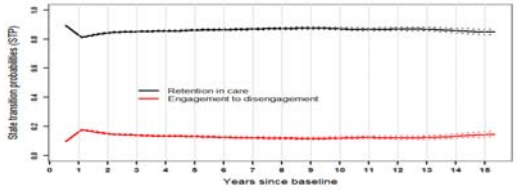


Figure 3. Temporal trend in retention and disengagement from care among care-engaged patients over 15 years of follow-up period.

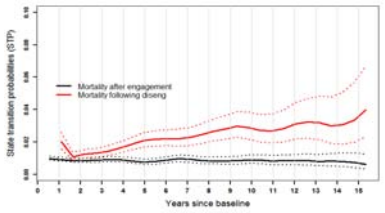


Figure 4. Temporal trend in mortality rates over 18 years of follow-up period: Black and red solid lines represent mortality rate following engagement in care and following disengagement from care, respectively.

Effect of clinical characteristics: Lower CD4 counts (<250), higher viral load, and not initiating ART are consistently associated with disengagement, lost, and death. AIDS defining illness is a strong predictive factor for most unfavorable transitions.

Race/Ethnicity disparity: Reverse racial disparity than existing results in long-term retention behaviors were found - Among engaged, Caucasians are at the highest risk of transitioning to death. Among disengaged, Caucasians are at higher risk of continued disengagement, being lost, and death. No difference in long-term retention between Hispanic and non-Hispanic was found.

Effect of behavioral and HIV risk factors: Age and gender-HIV risk factors were significantly associated.

Prior state		Engaged			Disengaged			
Current state		Eng.	Disen.	Death	Eng.	Disen.	Lost	Death
Overall STR		0.86	0.13	0.01	0.24	0.58	0.16	0.02
RRR	**CD4 counts**	reference state			reference state			
	250-500	-	0.84*	0.28*	-	0.98	0.98	0.48*
	>500	-	0.79*	0.16*	-	0.88*	0.86*	0.28*
	Viral load	-	1.25*	1.27*	-	1.06*	0.99	1.26*
	ART	-	0.83*	0.65*	-	0.82*	1.13*	0.75*
	AIDS	-	0.74*	2.84*	-	0.72*	0.85*	1.29*
	Race							
	AA	-	1.02	0.87*	-	0.89*	0.70*	0.84*
	Others	-	1.04	0.64*	-	0.95	0.94	0.83
	Hispanic	-	0.78*	0.77	-	0.99	0.90*	1.04
	Age>40	-	0.76*	1.66*	-	1.08*	1.11*	2.09*
	Gender & HIV risk factors*							
	MSM IDU	-	1.05	1.33*	-	1.03	0.91	1.61*
	MH-NIDU	-	1.10*	1.42*	-	0.87*	0.80*	1.06
	MH-IDU	-	1.15*	1.78*	-	1.17*	0.77*	1.83*
	FH-NIDU	-	0.99	1.04	-	0.95	0.97	0.94
	FH-IDU	-	0.86*	1.05	-	0.93	0.85	1.19

Table 1. Effect of known determinants of retention in clinical care

CONCLUSIONS

The proposed approach is the first attempt to capture all possible transition dynamics in longitudinal engagement and retention in care and to find determinants of the transitions. Beyond binary retention status, more comprehensive longitudinal patient behaviors should be examined.
Our findings can be used for policy, clinical, and programmatic purposes to enhance retention in care.

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