Local Social Network Features Predict HIV Testing Uptake in a Rural Ugandan Community

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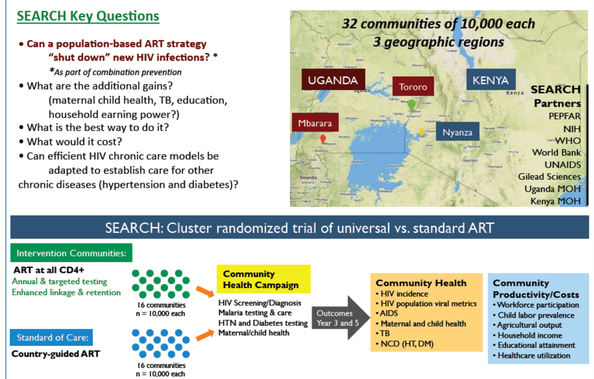
BACKGROUND

- Community-wide mobile HIV testing campaigns can rapidly increase HIV testing coverage and identify undiagnosed cases.
- Understanding social dynamics behind campaign participation and HIV testing may provide novel mobilization strategies to achieve high campaign participation and testing coverage more efficiently.
- We evaluated whether social network data predicted baseline testing uptake in a community-wide mobile HIV testing campaign in a single rural Ugandan community included in the SEARCH Trial (NCT01864603) .

Objectives:

- **Methodology:** To construct a complete community-wide social network on adult residents in a rural community in Uganda, using social contacts named during a community-wide household census.
- **Application**: To evaluate whether social network characteristics predict testing uptake in a baseline community-wide mobile HIV testing campaign.

The SEARCH Trial



METHODS

Data Collection:

- During a baseline population-wide census**, demographic information and social network contact information** across 5 social domains (health, money, emotional, food sharing, free time) were collected from all adults (15 years or older) in the community.
- At baseline, through **a hybrid approach of community health campaigns (CHC) followed by home based testing (HBT) for non-attendees**, we tested 94% of enumerated adult stable residents (82% by CHC, 12% by HBT).





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METHODS

Social Network Construction:

1. We established social links between enumerated adults in the community by matching contact records with census records using **a benchmarked, community-tailored, and semiautomated record linkage algorithm**.
2. Based on the resulting community-wide social network (SN), for each adult we obtained **SN characteristics**
   - the number of named contacts for each social domain
   - local network density (proportion of realized links among all possible)
   - local network clustering (proportion of trios that are fully connected)
   - a centrality measure of an individual's position within the overall community.
3. We further constructed **a subnetwork of adults known to be HIV+ at baseline**. Its structural features were compared to 1000 simulated populations of the same prevalence and network topology but randomly assigned HIV status.

Statistical Analysis of SN predictors of testing uptake:

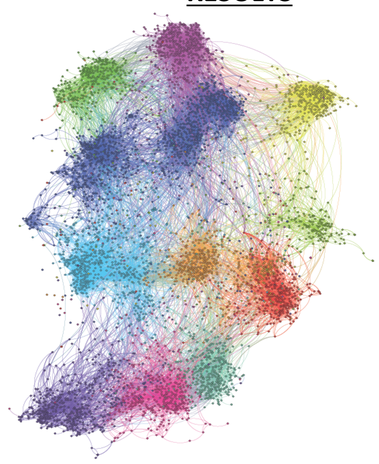
1. **Identifying candidate SN predictors of uptake outcomes:** We first applied a univariate analysis to identify potential SN predictors of not attending CHC and not testing by the hybrid approach.
2. **Data-adaptive learning of demographic confounders of uptake outcomes:** We used Super Learner to data-adaptively identify the subset of demographic variables (age, sex, marital status, occupation, education, wealth).
   - Super Learner is a machine learning algorithm that uses internal data splits to build an optimal predictor from a library of predictors.
3. **Adjusted association analysis with cluster-robust standard errors:** For each candidate SN predictor (identified in step 1), we perform a separate association analysis using a logistic regression, controlling for demographic confounders (identified in step 2). Standard errors are obtained using robust sandwich estimator with clustering by village.

RESULTS

Social Network:

- The complete social network for 4810 adults contained 25148 links across all five domains, with 96% of individuals connected through mutual contacts.
- The proportion of trios that are fully connected is 17%, and it takes an average of 4.7 contacts to connect any two individuals in the community.
- The subnetwork of 100 HIV+ adults was denser and had more fully connected subgroups of size >=4 than expected by chance ($p < 0.05$), and showed multiple social links to non-testers.

RESULTS



***Community-wide social network**: Nodes (persons) are color-coded by village, lines represent social links between persons.*

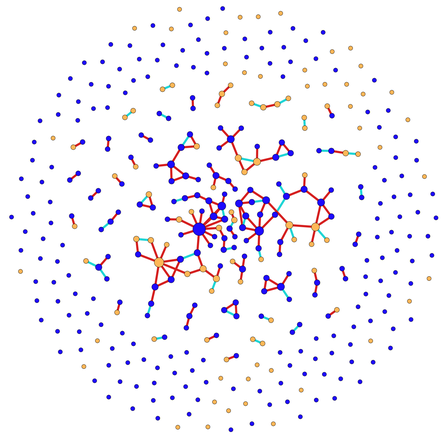
Adjusted Analysis: Predicting HIV Testing Uptake

Outcomes	Not attending Community Health Campaign (CHC)	Not testing by the hybrid approach
SN predictors	**Adj. OR (95% CI)**	**Adj. OR (95% CI)**
Fewer named emotional contacts	1.15 (1.07, 1.23)	1.17 (1.04,1.32)
Fewer named money contacts	1.16 (1.09, 1.24)	1.20 (1.08, 1.33)
Fewer named health contacts	1.14 (1.06, 1.23)	1.19 (1.06, 1.35)
Fewer named food-sharing contacts	1.20 (1.15, 1.26)	1.23 (1.14, 1.33)
Fewer named free-time contacts	1.18 (1.11, 1.25)	1.24 (1.11, 1.38)
Local network density	3.58 (2.49, 5.16)	2.91 (1.47, 5.74)
Local network clustering.	1.78 (1.06, 2.97)	
Local network size	0.97 (0.95, 0.98)	
Individual centrality in whole network	0.03 (0.01, 0.11)	0.01 (0.002,0.06)

Separate adjusted analysis for each SN predictor and outcome of interest, controlling for demographic confounders.

- Across all social domains, those with fewer named contacts were both less likely to attend CHC and less likely to test by the hybrid approach.
- Individuals with dense local networks have the highest risk for both not attending CHC and not testing by the hybrid approach.
- Local network clustering is associated with increased likelihood of not attending CHC.
- Individuals with higher centrality within overall community are more likely to both attend CHC and test for HIV.

RESULTS



***Subnetwork of baseline HIV+ (yellow nodes) and non-testers (blue nodes):** blue links means same household, red links means different households.*

CONCLUSIONS

- We may achieve high testing coverage more efficiently through social network-based mobilization strategies that target 1) individuals with less social support and 2) penetrate dense and clustered local networks.
- Social network data identified connected groups of HIV+ individuals that are denser than would be by chance. These HIV+ cases also have social links to multiple non-testers and can potentially be used to identify hidden high-risk individuals.

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