CHANGING RISK OF HIV IN RAKAI, UGANDA ACROSS BEHAVIORAL AND DEMOGRAPHIC CLUSTERS

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BACKGROUND

- New HIV infections have declined substantially in eastern Africa with the introduction of combination HIV interventions (CHI).
- However, it is unknown whether incidence has declined throughout the population or whether ongoing transmission is driven by subgroups of the population with relatively higher HIV incidence.

METHODS

- **Study population**: We analyzed data collected between 1999 and 2016 from the Rakai Community Cohort Study (RCCS), an open population-based HIV surveillance cohort in Uganda.
- **Cluster identification**: Population subgroups (i.e., clusters) were identified using k-means clustering based on demographic and sexual behavioral survey data excluding HIV status. The optimal number of clusters was determined based on parsimonious prediction of HIV status (i.e., optimizing AIC in regression models using cluster as exposure).
- **Temporal trends**: Cluster size, HIV incidence rates and proportion of HIV incident cases attributable to each cluster were estimated within three CHI calendar epochs (pre CHI: 1999–2004; early CHI: 2005–2011; late CHI: 2011–2016).
- **Counterfactual analyses:** To estimate relative contributions of changes in cluster size (i.e., people moving from high- risk clusters to low-risk clusters) versus changes in HIV incidence (i.e., within-cluster reductions in HIV incidence) to population-level changes in HIV incidence, we performed a counterfactual analyses.

HIV incidence has declined across most behavioral and demographic population subgroups in southern Uganda with scale-up of combination HIV interventions.

Population-level declines in HIV incidence were largely accounted for by incidence reductions within population subgroups consistent with widespread impact of combination HIV interventions.

RESULTS

- 33,866 individuals contributed 102,759 person-visits to the analysis.
- **Thirteen population clusters were identified** from RCCS demographic and sexual behavioral data.
- At baseline (pre-CHI epoch) incidence ranged from 0.0/100 py in Cluster 1 to 3.6 /100 py in Cluster 13. (Fig. 1). Highest risk clusters were comprised predominately of unmarried persons <30 years.
- **HIV incidence declined** in all population clusters with the exception of cluster 1 (Fig. 2; far left panel).
- **Low-risk clusters generally increased in size** while high risk clusters mostly decreased or remained similar in size (Fig. 2; middle panel).
- The proportion of incident HIV cases that each cluster accounted for generally decreased in the lowest risk clusters but remained stable or increased in higher risk clusters. (Fig. 2, far right panel).
- In counterfactual analyses, **HIV incidence trends were almost entirely (93%) explained by declines in within-cluster HIV incidence rates** (Fig. 3)

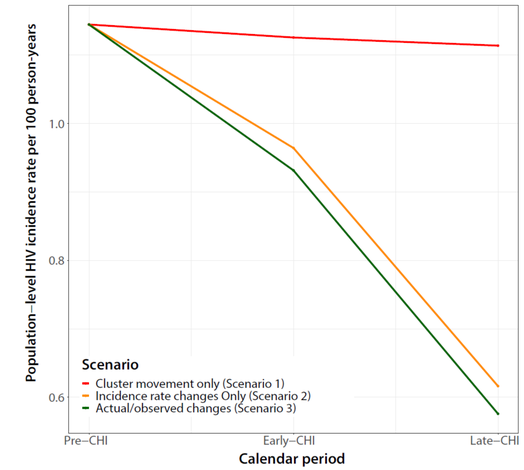

Figure 3. Population-level HIV incidence under three scenarios: 1) changes only occur in cluster size over time but incidence remains constant (red line); 2) changes occur in incidence but cluster sizes remain at baseline levels throughout the study period (orange line); and 3) incidence changes as observed in the data (blue line).

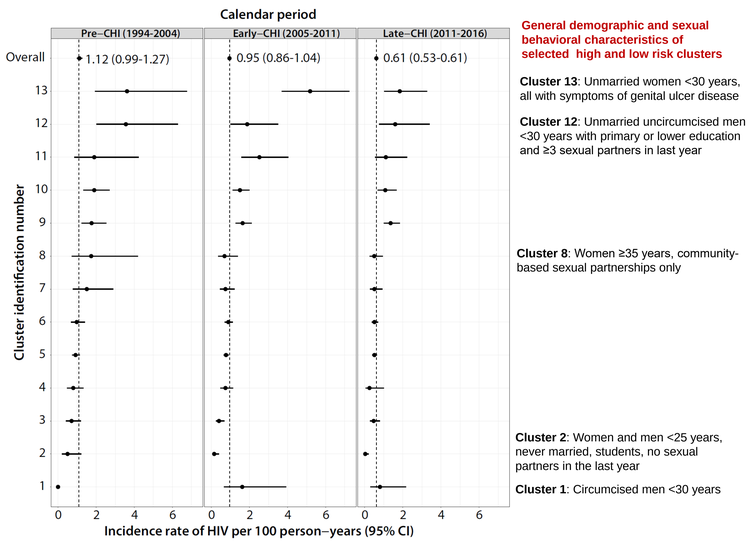

Figure 1. HIV incidence rates with 95%CI over time by cluster. Clusters are numbered in ascending order based on pre-CHI incidence levels (e.g., Cluster 1 had the lowest pre-CHI incidence and Cluster 13 had the highest). The dashed black line represents the overall incidence of HIV within each calendar epoch. Note: There were no HIV incident cases in the first cluster during the pre-CHI period..

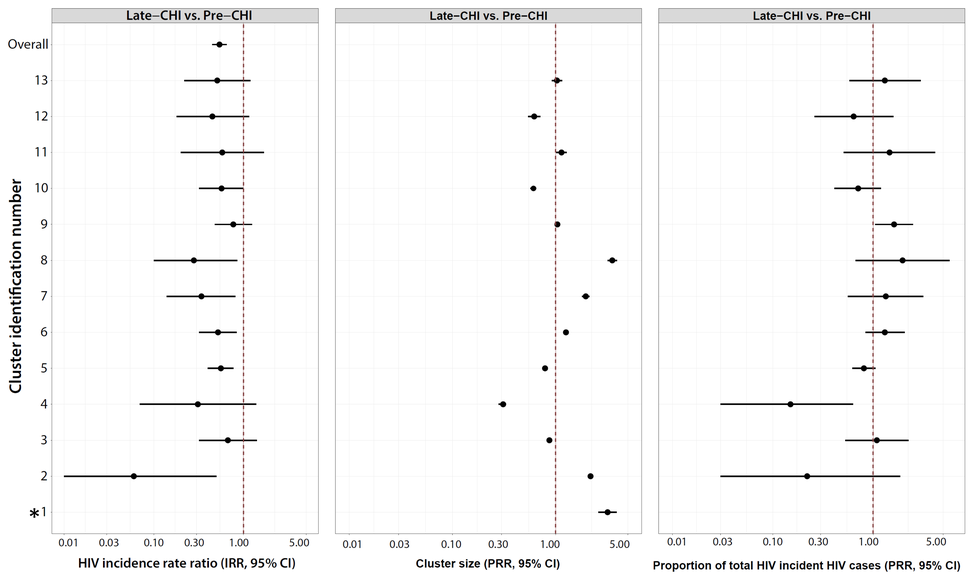

Figure 2. Within cluster relative HIV incidence rate, cluster size, and proportion of incident cases by cluster comparing the late-CHI to early-CHI calendar periods. Clusters are rank ordered based on pre-CHI HIV incidence. *Cluster 1 contributed zero HIV incident cases in the early-CHI period. The dashed red line is marked at 1.

CONCLUSIONS

- In southern Uganda, HIV incidence declined in nearly all population subgroups, with most incidence declines likely attributable to CHI interventions versus changes in population demographics or sexual behaviors.
- Targeted strategies may be needed to further reduce HIV risk in population subgroups accounting for high HIV incidence and most new infections.
- This work is currently being extended to include more recently collected survey data.

ADDITIONAL KEY INFORMATION

Funding

- National Institute of Allergy and Infectious Diseases
- National Institute of Mental Health
- Eunice Kennedy Shriver National Institute of Child Health and Human Development
- Centers for Disease Control and Prevention
- Johns Hopkins University Center for AIDS Research

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