Epidemiology and Viral Dynamics of HIV in the Rakai Community Cohort Study Informing Policy and Programs

Ronald Gray on behalf of Kate Grabowski
(and Adam)
The African HIV epidemic: the good news

- HIV incidence is declining in Rakai and other African countries.
- However, no country is on track to reach epidemic control by 2030.
- The future course of the epidemic and ultimate control of HIV depend on identifying and targeting populations with ongoing transmission.

HIV incidence in sub-Saharan Africa, 1997-2018
UNAIDS, 2018

Grabowski, NEJM, 2019
What is needed for epidemic control?

We need to understand HIV epidemic dynamics during declining incidence and as new and existing interventions are rolled out.

- Who is getting infected?
- Who is infecting whom?
- What is the role of migration?
- What is the role of priority/key populations (e.g., fishing communities)?
- Changes in viral infectivity/virulence?
- Viral suppression on ART/drug resistance?
Where do new HIV infections in Rakai come from?

- 39% of transmissions occurred within households

- 40% of transmissions were from extra-household partners of whom 62% had partners from outside the community.

- There were no transmissions if the partner was on ART

Do high prevalence/incidence fishing communities spread infection to larger inland populations?

NIAID: R01AI110324
Fishing communities have the highest prevalence, but smaller populations. Most infections are in larger inland populations.

Chang et al. Lancet HIV. 2016
HIV+ and Migration in RCCS communities

- High migration of HIV positive persons into fishing communities
- Diffuse and low prevalence out-migration from fishing to inland

Akullian et al. *HIV Dynamics Evol.* 2018
Migrants contribute most newly detected HIV infections in RCCS; 2011-2015

Most newly identified HIV infections in RCCS are among in-migrants

Olawore et al. *Lancet HIV*. 2018
Recent migrants have high HIV incidence <2 years after arrival

- High incidence in recent migrants
- ART use is lower in migrants than residents
- There is need to rapidly enroll new migrants into treatment and prevention services

**Figure 1**: HIV incidence by year since migration
Bars are 95% CIs.
Phylogenetics and Networks for Generalised Epidemics in Africa (PANGEA)

% HIV prevalence (UN AIDS 2016)
- <0.1
- 5
- 10
- 15
- 20
- 25
Inferring the direction of HIV transmission between communities

- Used blood samples from HIV-infected participants not on ART with detectable viral loads

- Viral RNA deep sequenced using Next Generation Sequencing.

- Phylogenetic analysis used to infer partial HIV transmission networks and probability of direction of transmission.

Reconstruction of HIV transmission networks and direction of transmission with viral deep sequence phylogenetic data

Conclusion: Do fishing communities drive the epidemic in the general inland populations of Rakai?

- High prevalence/incidence fishing communities have lower numbers of HIV+ persons than larger inland populations.

- Fishing communities attract HIV+ in-migrants, but account for only a small proportion of transmissions to inland communities.

- Targeting HIV services to fishing communities is important, but is unlikely to affect incidence in the larger inland populations in Rakai.
### Viral load suppression for HIV positives

<table>
<thead>
<tr>
<th>Category of Suppression</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppressed viral load</td>
<td>80</td>
</tr>
<tr>
<td>Loss of suppression</td>
<td>3</td>
</tr>
<tr>
<td>Persistent Viremia</td>
<td>16</td>
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</tbody>
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- Viral load suppression for HIV+ increases with duration of treatment
- **Persistent viremia is higher in young men, who need extra targeting**
- No transmitted resistance detected yet in Rakai
HIV subtypes are evolving and diversifying in Rakai

- HIV Subtype D is declining in frequency; Viral recombinants and Subtype A are increasing.

- Disease progression faster with subtype D, infectivity greater with subtype A

- A is displacing D

Summary of results

- HIV incidence is declining due to ART and VMMC.
- HIV incidence remains high in fishing communities and mobile/migratory populations.
- Fishing communities do not appear to drive transmission in low prevalence areas.
- Durable viral load suppression is increased with ART; but a minority, particularly young men remain unsuppressed (“hard-to-reach/engage”) and have the highest viral loads.
- The HIV epidemic is diversifying
- Epidemic control remains a major challenge