Population HIV Viral Load in Swaziland: Assessing ART Program Effectiveness and Transmission Potential

Jessica Justman1, Tanya M. Ellman2, Deborah Donnell3, Yen T. Duong4, Jason Reed4, George Bicego5, Peter Ehrenkranz5, Joy Chang4, Lei Wang3, Naomi Bock4 and Rejoice Nkambule6 for the SHIMS Study Team

1Columbia University, ICAP, Mailman School of Public Health, New York, United States, 2Columbia University Medical Center, Medicine, New York, United States, 3Fred Hutchinson Cancer Research Center, Seattle, United States, 4Centers for Disease Control and Prevention, Atlanta, United States, 5Centers for Disease Control and Prevention, Mbabane, Swaziland, 6Ministry of Health - Swaziland, Mbabane, Swaziland

Abstract # 96
CROI, March 5, 2013
The Kingdom of Swaziland

- Population: 1.2 million
- Highest HIV prevalence and incidence in the world: 26% in 2006 (DHS) and 2.7% (UNAIDS 2009)
- HIV prevention campaign launched 2011—expanded male circumcision and ART—to curb epidemic
- HIV incidence measurements needed to demonstrate impact
Swaziland HIV Incidence Measurement Survey
SHIMS

Cohorts: 18-49 year old men and women

Prevalence: 31%
Incidence: 2.4%*

Follow-up Incidence

HIV Prevention and Treatment Campaign

Cohort 1

Cohort 2

HIV Testing & HIV-RNA

* Nkambule, R et al. CROI 2012; Reed, J. et al., IAS 2012
Current Analysis:

To describe the distribution of HIV viral load in the Swaziland population
Methods: Study Procedures

- Select nationally-representative sample of households
- Survey of eligible household members: Questionnaire & HIV testing/counseling
- HIV-negative survey participants
- Offer enrollment in incidence cohort
Methods: Study Procedures

1. Select/visit nationally-representative sample of households
2. Survey of eligible household members
   - Questionnaire & HIV testing/counseling
3. HIV-negative survey participants
   - Offer enrollment in incidence cohort
4. HIV-positive survey participants
   - Refer to HIV care & treatment
   - HIV RNA measurements
HIV RNA testing:

- Blood samples collected from participants and transported to National Reference Laboratory in Swaziland within 24 hours for processing into plasma aliquots

- All seropositive samples analyzed using automated platform:
  
  Cobas AmpliPrep/Taqman HIV-1 test, v2.0

- Limit of detection: 20 - 10,000,000 copies/ml
Viral load data are presented for the following:

- **Total**: total population-based cohort
- **Unaware**: unaware of HIV+ status prior to SHIMS
- **Aware**: aware of HIV+ status
  - Not on ART: reported no current ART use
  - On ART: reported current use of ART
- **High viral load**: >50,000 c/ml
- **Low viral load**: <1,000 c/ml
Statistical Methods

- SHIMS sample weighted to adjust for sampling methods and differences in non response and to achieve population representativeness

- Statistical methods for multistage surveys used throughout
Results
Total # potentially eligible household members: 24,484* (Dec ‘10- June ‘11)

- No contact: 3,812* (15%)  
- Refused: 2,493* (10%)  
- Participated: 18,179* (74%)

- HIV+: 5,802* (32%)  
- HIV-Neg: 12,370* (68%)

*unweighted
Total HIV + participants 5,841†

- No VL sample
  13 (<1%)

- Viral load done
  5,828 (99%)

Unaware of HIV+ diagnosis
2,156 (37%)

Aware of HIV+ diagnosis
3,672 (63%)

Reports No ART
1,909 (52%)

Reports ART
1,763 (48%)
## HIV+ adults in Swaziland, age 18-49y

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>34%</td>
</tr>
<tr>
<td>Women</td>
<td>66%</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
</tr>
<tr>
<td>Married/Partnered</td>
<td>55%</td>
</tr>
<tr>
<td>Single</td>
<td>45%</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>40%</td>
</tr>
<tr>
<td>30-39</td>
<td>39%</td>
</tr>
<tr>
<td>40-49</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Rural residence</strong></td>
<td>70%</td>
</tr>
</tbody>
</table>
Mean Population VL and Components

Mean HIV-RNA copies/ml

Total and components

- Total
- Unaware
- Aware
Mean Population VL and Components

Bar chart showing mean HIV-RNA copies/ml for different components:
- **Total**
- **Unaware**
- **Aware**
- **On ART**
- **No ART**

The y-axis represents the mean HIV-RNA copies/ml ranging from 0 to 140,000. The x-axis is labeled as follows:
- **Total and components**
- **Aware and components**
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>94,644</td>
<td>14,471</td>
</tr>
<tr>
<td>n = 5,828</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unaware</strong></td>
<td>129,307</td>
<td>52,081</td>
</tr>
<tr>
<td>n = 2,156</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aware</strong></td>
<td>74,319</td>
<td>1,134</td>
</tr>
<tr>
<td>n = 3,672</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Current ART</td>
<td>22,979</td>
<td>0</td>
</tr>
<tr>
<td>n = 1,763</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-No ART</td>
<td>129,260</td>
<td>39,755</td>
</tr>
<tr>
<td>n = 1,909</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SHIMS: DISTRIBUTION OF VL

VL categories
- VL>50,000 c/ml
- VL 1,000-49,999 c/ml
- VL <1,000 c/ml
- VL<20 c/ml
## Distribution of VL by Sex and Age

<table>
<thead>
<tr>
<th></th>
<th>VL &lt;1,000 (%)</th>
<th>VL &gt;50,000 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>32%</td>
<td>44%</td>
</tr>
<tr>
<td>Women</td>
<td>36%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>22%</td>
<td>40%</td>
</tr>
<tr>
<td>30-39</td>
<td>41%</td>
<td>33%</td>
</tr>
<tr>
<td>40-49</td>
<td>49%</td>
<td>29%</td>
</tr>
</tbody>
</table>
# Multivariable Model: High VL >50,000 c/ml

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>High Viral Load (VL&gt;50,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>aOR* (95% CI)</td>
</tr>
<tr>
<td><strong>Knowledge of HIV+</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unaware of HIV+ status</td>
<td></td>
<td>14.6 (12.1, 17.77)</td>
</tr>
<tr>
<td>Aware, No ART</td>
<td></td>
<td>13.2 (10.8, 16.07)</td>
</tr>
<tr>
<td>Aware, Current ART</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td>1.96 (1.73, 2.22)</td>
</tr>
<tr>
<td><strong>Age (y)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td></td>
<td>1.07 (0.91, 1.26)</td>
</tr>
<tr>
<td>30-39</td>
<td></td>
<td>1.01 (0.86, 1.19)</td>
</tr>
<tr>
<td>40-49</td>
<td></td>
<td>1.0</td>
</tr>
</tbody>
</table>

*adjusted for region and marital status
Of all with HIV infection in Swaziland, 35%, regardless of ART use, have viral suppression <1000 c/ml
Of all with HIV infection in Swaziland, 28% have ART-related viral suppression <1000 c/ml
Summary

• First national estimate of population viral load, performed among a household-based, nationally representative HIV+ group

• Unique opportunity to compare aggregate VL measures across different groups
  • VL distribution of unaware and untreated similar

• Men twice as likely to have high VL
  • Independent of being less likely to be diagnosed
Conclusions

- Evidence of an effective ART program
  - 85% of those who report current ART use have VL<1000

- Yet transmission potential is high, with 65% of HIV+ adults, regardless of ART use, not virally suppressed

- Time to move to precise terminology in describing estimates of HIV viral load in order to “know your epidemic”
Thanks to the women and men in SHIMS
## Acknowledgements

**Protocol Team**
- *Rejoice Nkambule*
- *George Bicego*
- *Naomi Bock*
- Muhle Dlamini
- Deborah Donnell
- Dennis Ellenberger
- Tedd Ellerbrock
- Wafaa El-Sadr
- Jonathan Grund
- *Jessica Justman*
- Amy Medley
- Jan Moore
- Emmanuel Njeuhmeli
- *Jason Reed*
- Nelisiwe Sikhosana

**CDC Swaziland**
- Peter Ehrenkranz
- Ahmed Liban
- Khosi Makhanya

**CDC Atlanta**
- Anindya De
- Joy Chang
- Josh DeVos
- Yen Duong
- Dennis Ellenberger
- Al Garcia
- Carole Moore
- John Nkengasong
- Michele Owen
- Bharat Parekh
- Hetal Patel
- Connie Sexton
- Chunfu Yang

**Nat’l Ref Laboratory**
- Hosea Sukati
- Sindi Dlamini
- All Laboratory Scientists

**ICAP in Swaziland**
- Alfred Adams
- Kerry Bruce
- Gcinekile Dlamini
- Ndumisi Dlamini
- Sindisiwe Dlamini
- Henry Ginindza
- Sibuse Ginindza
- Alison Koler
- Yvonne Mavengere
- Khudzie Mlambo
- Phakamile Ndlangamandla
- Ingrid Peterson
- Nicola Pierce
- Bhangazi Zwane

**SCHARP**
- Claire Chapdu
- Lynda Emel
- Iraj Mohebian
- Lei Wang
- Cherry Mao
- Keala Li
- Casey Herron

**ICAP at Columbia University**
- Elizabeth Barone
- Montina Befus
- Mary Diehl
- Briana Diehl
- Mark Ferrigno
- Mark Fussell
- Allison Goldberg
- Leslie Horn
- Jacqueline Maxwell
- Joan Monserrate
- Neena Philip
- Peter Twyman
- Leah Westra
- Allison Zerbe

**Epicentre/Maromi Health Research**
- Cherie Cawood
- Mark Colvin
- David Khanyile
- Nomsa Nzama
- Phindile Radebe
- All Regional Managers
- All field teams
Acknowledgements

Swaziland Ministry of Health
and
Central Statistical Office