Estimating National HIV Incidence from Directly Observed Seroconversions in the Swaziland HIV Incidence Measurement Survey

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Abstract # FRLBX02
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The Kingdom of Swaziland

- Population: 1.2 million
- Highest HIV prevalence and incidence in the world:
  - Prevalence of 26%*
  - Estimated incidence of 2.66%** among men & women 15-49 yrs
- HIV prevention campaign launched 2011—expanded male circumcision and ART—to curb epidemic
- HIV incidence measurements needed to demonstrate and quantify impact

* 2007 DHS  **2009 UNAIDS
Primary Objective

- Assess change in HIV incidence following expanded HIV prevention and treatment programs in Swaziland
SHIMS: Study Design

LEGEND

Cohorts
18-49 year old men and women

HIV testing

Cohort 1
Baseline Incidence

HIV Prevention and Treatment Campaign

Cohort 2
Follow-up Incidence

6 0 12 24 30 36
SHIMS: Study Design

LEGEND

Cohorts 18-49 year old men and women

Baseline Incidence

HIV Prevention and Treatment Campaign

Follow-up Incidence

HIV testing
To directly estimate baseline HIV incidence in a household based, nationally representative sample of men and women in Swaziland, based on observed seroconversions
SHIMS: Methods

SHIMS SAMPLE: 575 Enumeration Areas (EAs)

Legend
- Tarmad Roads
- Region Boundary
- SHIMS EAs
SHIMS: Methods

Select/visit nationally-representative sample of households (began Dec 2011)

Survey of eligible household members
Questionnaire & HIV testing/counseling

HIV-positive survey participants
Refer to HIV care & treatment

HIV-negative survey participants
Offer enrollment in the cohort

Follow-up at 6 months
Questionnaire & HIV testing/counseling
SHIMS: Laboratory Methods

Field Level HIV Testing Algorithm

4th Generation Determine Ag/Ab

Ag (-) / Ab (-) → Interpretation HIV Negative (cohort eligible)

Ag (+) / Ab (+) → Perform UniGold
- Reactive → Interpretation HIV Positive (refer to care & treatment)
- Non-reactive → Interpretation Indeterminate

Ag (+) / Ab (-) → Perform UniGold
- Reactive → Interpretation Indeterminate
- Non-reactive → Send to NRL

Ag (-) / Ab (+) → Perform UniGold
- Reactive → Interpretation HIV Positive (refer to care & treatment)
- Non-reactive → Interpretation Indeterminate
Laboratory Level HIV Testing Algorithm

Ag (+) / Ab (+) → Perform UniGold

- Non-reactive: Interpretation Indeterminate → Perform Enzyme Immuno-Assay (EIA)
  - EIA (+): Interpretation HIV Positive (return result within 2 weeks; refer to care & treatment)
  - EIA (-): Interpretation HIV Negative (return result within 2 weeks; cohort eligible)

- Reactive: Interpretation Indeterminate → Perform NAT
  - NAT (-): Interpretation HIV Negative (repeat blood draw/retest within 6 weeks; cohort eligible)
  - NAT (+): Interpretation Indeterminate (repeat blood draw/retest within 6 weeks; cohort ineligible)

Ag (-) / Ab (+) → Non-reactive

Ag (+) / Ab (-) → Perform UniGold

- Non-reactive: Interpretation Indeterminate → Perform NAT
  - NAT (-): Interpretation HIV Negative (repeat blood draw/retest within 6 weeks; cohort eligible)
  - NAT (+): Interpretation Indeterminate (repeat blood draw/retest within 6 weeks; cohort ineligible)
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. Poisson regression models used to estimate seroincidence rates. Proportional Hazards Regression used to model risk factors for seroconversion
Results
SHIMS Household Survey Participation

Household Survey

Visited
14,931

- No contact
  1,556 (13%)
- Contact made
  12,983 (87%)
SHIMS Household Survey Participation

Household Survey

Visited 14,931

- Contact made 12,983 (87%)
- No contact 1,556 (13%)

Refused 705 (5%)

Completed 12,278 (95%)
SHIMS Survey/Cohort Participation

Total potential participants 24,462

- No contact: 3,660 (15%)
- Refused: 2,493 (10%)
- Agreed to Participate: 18,154 (74%)
**SHIMS Survey/Cohort Participation**

- Total potential participants: 24,462
- Participated: 18,154 (74%)
- Not eligible: 5,760 (32%)
- Cohort Eligible/ HIV-neg: 12,357 (68%)
- Refused: 2,493 (10%)
- No contact: 3,660 (15%)
Total potential participants 24,462

- No contact 3,660 (15%)
- Refused 2,493 (10%)
- Participated 18,154 (74%)

- Not eligible 5,760 (32%)
- Cohort Eligible/HIV-Neg 12,357 (68%)

- Refused 477 (4%)
- Enrolled in Cohort 11,880 (96%)
SHIMS Survey/Cohort Participation

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Cohort Eligible/HIV-Neg 12,357 (68%)

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Not Retained 725 (6%)

Follow-Up Completed 11,155 (94%)
SHIMS Survey/Cohort Participation

Total potential participants 24,462

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  - Enrolled in Cohort: 11,880 (96%)
    - Follow-Up Completed: 11,155 (94%)
  - Refused: 477 (4%)
  - Not Retained: 725 (6%)
## Swaziland Demographics: HIV-Negative Adults (Ages 18-49)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Number</td>
<td>11,840</td>
<td>6,025</td>
<td>5,815</td>
</tr>
<tr>
<td>Age, mean (years)</td>
<td>28.3</td>
<td>27.4</td>
<td>29.3</td>
</tr>
<tr>
<td>Rural census tract</td>
<td>70%</td>
<td>71%</td>
<td>70%</td>
</tr>
<tr>
<td>Education, HS or &gt;HS</td>
<td>68%</td>
<td>69%</td>
<td>68%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>45%</td>
<td>34%</td>
<td>57%</td>
</tr>
<tr>
<td>Not married nor living with partner</td>
<td>59%</td>
<td>70%</td>
<td>48%</td>
</tr>
<tr>
<td>Sexually active*</td>
<td>70%</td>
<td>63%</td>
<td>78%</td>
</tr>
<tr>
<td>&gt;2 sex partners*</td>
<td>10%</td>
<td>17%</td>
<td>3%</td>
</tr>
<tr>
<td>Consistent condom use*</td>
<td>19%</td>
<td>20%</td>
<td>17%</td>
</tr>
</tbody>
</table>

* *In the 6 months prior to interview*
AGE DISTRIBUTION OF HIV-UNINFECTED POPULATION IN SWAZILAND
## HIV Incidence in Swaziland

<table>
<thead>
<tr>
<th></th>
<th>Sero-conversions</th>
<th>Person years of Follow-up</th>
<th>Incidence/100 PY</th>
<th>95% CI Incidence/100 PY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>143*</td>
<td>6,019</td>
<td>2.38</td>
<td>2.06, 2.75</td>
</tr>
<tr>
<td>Men</td>
<td>51</td>
<td>3,070</td>
<td>1.65</td>
<td>1.28, 2.11</td>
</tr>
<tr>
<td>Women</td>
<td>93</td>
<td>2,949</td>
<td>3.14</td>
<td>2.63, 3.74</td>
</tr>
</tbody>
</table>

*Sex disaggregated data do not sum to Overall due to rounding of weighted data*
HIV Incidence in Swaziland by Age and Sex

**Men: Incidence by Age**
(All ages = 1.65, CI 1.28-2.11)

**Women: Incidence by Age**
(All ages = 3.14, CI 2.63-3.74)
HIV Incidence in Swaziland by Age and Sex

Men: Incidence by Age

(All ages = 1.65, CI 1.28-2.11)

Women: Incidence by Age

(All ages = 3.14, CI 2.63-3.74)

3.12% in men aged 30-34

4.17% in women aged 20-24

4.09% in women aged 35-39
HIV Incidence in Swaziland by Age and Sex

HIV Incidence by Age and Gender

Age Group

HIV Incidence

18-19
20-24
25-29
30-34
35-39
40-44
45-49

Women
Men
# HIV Incidence & Demographics/Behaviors

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incidence/100PY</td>
<td>95% CI</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/living together</td>
<td>1.34 (0.79-2.27)</td>
<td>2.24 (1.52-3.02)</td>
</tr>
<tr>
<td>Not married /living together</td>
<td><strong>1.80</strong> (1.36-2.38)</td>
<td><strong>4.06</strong> (3.28-5.03)</td>
</tr>
<tr>
<td>Condom Use, past 6 mos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistent use</td>
<td>1.74 (1.05-2.89)</td>
<td>3.78 (2.65-5.37)</td>
</tr>
<tr>
<td>Inconsistent use</td>
<td><strong>2.70</strong> (2.01-3.61)</td>
<td>3.76 (3.03-4.66)</td>
</tr>
<tr>
<td># Sex Partners, past 6 mos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never had sex</td>
<td>0.15 (0.03-0.83)</td>
<td>0.71 (0.22-2.26)</td>
</tr>
<tr>
<td>0</td>
<td>0.40 (0.08-2.05)</td>
<td>1.21 (0.61-2.38)</td>
</tr>
<tr>
<td>1</td>
<td><strong>1.92</strong> (1.40-2.64)</td>
<td><strong>3.64</strong> (3.01-4.41)</td>
</tr>
<tr>
<td>≥ 2</td>
<td><strong>3.21</strong> (2.02-5.10)</td>
<td><strong>9.64</strong> (4.48-20.0)</td>
</tr>
<tr>
<td>MC Status, self report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circumcised</td>
<td>1.29 (0.71-2.33)</td>
<td>--</td>
</tr>
<tr>
<td>Uncircumcised</td>
<td><strong>1.74</strong> (1.32-2.30)</td>
<td>--</td>
</tr>
<tr>
<td>Pregnant, self report</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Predictors of Seroconversion
Multivariate Analysis

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(aHR*, 95% CI)</td>
<td>(aHR*, 95% CI)</td>
</tr>
<tr>
<td><strong>Age (y)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-19</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>20-24</td>
<td>1.01 (0.38-2.67)</td>
<td>2.03 (1.01-4.05)</td>
</tr>
<tr>
<td>35-39</td>
<td>0.20 (0.03-1.34)</td>
<td>2.85 (1.02-7.98)</td>
</tr>
<tr>
<td><strong>Relationship with Partner(s)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not married nor living w/partner</td>
<td>2.03 (0.91-4.53)</td>
<td>3.05 (1.64-5.69)</td>
</tr>
<tr>
<td>Married or living with partner</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Location of partner</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living elsewhere</td>
<td>2.31 (0.84-6.37)</td>
<td>2.81 (1.53-5.15)</td>
</tr>
<tr>
<td>Living with participant</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*adjusted for education, employment, geography, # sex partners and pregnancy (women)
## Predictors of Seroconversion (cont)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men (aHR, 95% CI)</th>
<th>Women (aHR, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partner’s HIV status (current partner)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not HIV-positive</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HIV-positive</td>
<td>2.06 (0.87-4.87)</td>
<td>1.88 (1.09-3.27)</td>
</tr>
<tr>
<td>Don’t know partner’s status</td>
<td>3.72 (1.97-7.05)</td>
<td>2.74 (1.53-4.92)</td>
</tr>
<tr>
<td><strong>Condom use, past 6 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not always</td>
<td>2.35 (1.16-4.73)</td>
<td>0.92 (0.57-1.46)</td>
</tr>
<tr>
<td>Always</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Circumcision status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncircumcised</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Circumcised</td>
<td>0.50 (0.22-1.12)</td>
<td></td>
</tr>
</tbody>
</table>
Strengths and Limitations

**Strengths**
- First national estimate using direct observation of seroconversions, performed on a household-based nationally representative population cohort
- >94% retention over 6 months

**Limitations**
- All results, other than HIV testing, are based upon self-reported information
Conclusions

- HIV incidence (2.38%) remains high in the Swaziland population

- Data reveal an unexpected second peak in incidence among women
  - Is this occurring in other populations or regions where HIV is hyper-endemic and of similar severity?

- Findings reinforce importance of knowing partner’s status, consistent condom use, and voluntary medical male circumcision for men
Women in their late 30s experience a risk of HIV similar to women in their early 20s, and prevention programs should target both age groups (as well as men).

Women who are not married/not living with a partner are at increased risk of HIV compared to women who are married/living with a partner.

Acceleration of effective interventions proven to reduce HIV infection has the potential to dramatically reduce HIV incidence in Swaziland.
## Protocol Team

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Kingdom of Swaziland & CSO

MINISTRY OF HEALTH

ICAP
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Mailman School of Public Health

CDC

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