2015 PHDL International Student Exchange Program

Faikah Bruce
PhD Student
SACEMA / Stellenbosch University
South Africa

Cape Town

Johannesburg

Port Elizabeth

Stellenbosch

Population: >54 million
Alex Welte, Wim Delva, and Reshma Kassanjee: Inferring Dynamical Rules vs. Inferring Instantaneous System States: The Case of Disease Surveillance with a Focus on HIV Incidence

Wim Delva and Alex Welte: Roadblocks and Detours from Models to Health Policy: Early, Wide-Scale Antiretroviral Treatment for HIV Prevention as an Example

University of Pittsburgh Graduate School of Public Health

Public Health International Modeling Fellows Initiative in 2011

October 2014

Prof. Alex Welte, Director
Dr. Wim Delva, Deputy Director
Ms. Cari van Schalkwyk, Researcher, Statistics

2010 - 2015

CEPHIA - Consortium for the Evaluation and Performance of HIV Incidence Assays

‘Development of specimen repository and evaluation of assays for identification of recent HIV infection and estimation of HIV incidence’
Background


Dr. Leigh Johnson (CIDER – UCT)
Prof. Alex Welte (SACEMA)

CHAMPS: Choices for HIV Adolescent Methods of Prevention in South Africa
• “Pluspills” - feasibility, acceptability and use of oral PrEP

Developed an online risk scoring tool – www.champsriskrater.co.za
• Assist adolescents in quantifying their risk of HIV infection
• To quantify the extent to which adolescents can lower their risk with the new prevention methods
Background

Welcome to the Champs Risk Rater
Together we can end the HIV epidemic in our beautiful continent!

This website is designed to:
1. Provide you with an open and safe platform to explore safe HIV prevention methods.
2. Empower you as an individual to make smarter choices.
3. And most importantly, give you an opportunity to make a difference!

The program that follows consists of 3 parts:
1. You can find out what your current chance of being HIV infected are.
2. Explore your chances of becoming HIV infected over one year.
3. Explore how you can change your risk of becoming HIV infected over one year by using HIV prevention methods.

How can you bring an end to the HIV epidemic? Click here to get started.

Step 1: Results
Your current chance of being HIV positive is indicated by the arrow on the scale below:
- Low
- Medium
- High
- Very High

This is the average risk of HIV infection in people with your characteristics, but individual HIV risk might vary a lot from person to person.

Click here to find out your risk of becoming HIV infected over one year.

Step 2: Results
If your behaviour next year stays the same as it has been in the last year, then your risk of becoming infected in the next year is indicated by the arrow on the scale below:
- Low
- Medium
- High
- Very High

Click here to find out how you can change your risk of becoming HIV infected over one year.

The risk shown above was calculated based on the information below and the information you provided about your partner:
- Age 18
- Sex Female
- Number of partners: 2

Step 3: Results
Before:
Your risk of becoming HIV positive over the next year was as indicated by the arrow on the scale below:

This risk was calculated based on the information below and the information you provided about your partner:
- Age: 18
- Sex: Female
- Number of partners: 2

After:
Your risk of becoming HIV positive over the next year is now as indicated by the arrow on the scale below:

The prevention methods listed are:
- Use an condom
- Use PrEP/Truvada is only effective in preventing HIV infection if it is taken every day.

Click here if you would like to alter your selection of prevention methods to see how you can further reduce your risk of becoming HIV infected.
If you have completed and are happy with your choices, click here.
PHDL Project - Objectives

Advisor: Dr. Mark Roberts

- Measles
- Influenza

- Airborne
- Proximity

- Chikungunya
- Dengue

- Vector-borne
- Density population

- HIV
- Hepatitis C

FRED
Framework for Reconstructing Epidemiological Dynamics

Model Dynamics of HIV?
The dynamics of an HIV epidemic

1. Disease progression of an HIV-infected agent
   - Impact of HAART

2. Social Network Model
   - Types of HIV transmission
     - Sexual
     - Injecting drug use

3. Probability of HIV infection

4. HIV mitigation strategies
**HIV Mitigation Strategies**

**Biomedical**
- PrEP
- Antiretroviral-based microbicides (ARV-M)
- Condoms
- Medical male circumcision (MMC)
- Vaccines

**Behavioural**
- Rehab Programs
- Needle Exchange Programs
- HIV Testing and Awareness Programs

**HIV Mitigation Strategies**

**Vaccines**

**PrEP**

**Antiretroviral-based microbicides (ARV-M)**

**Condoms**

**Medical male circumcision (MMC)**

**Rehab Programs**

**Needle Exchange Programs**

**HIV Testing and Awareness Programs**
Things to consider when implementing PMs

- Current level of protection/prevention
  - Condom use
- Acceptability
- Uptake
- Adherence
- Efficacy
- Duration of use

- Correlations
  - Condom use and acceptability
  - Acceptability and adherence

- Risk compensation
<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Results</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPerGAY (MSM)</td>
<td>France, Canada</td>
<td>Protective effect:</td>
<td>&gt; 80% (drug levels in blood plasma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 86% (95% C.I. 39.4-98.5)</td>
<td></td>
</tr>
<tr>
<td>PROUD (MSM)</td>
<td>England</td>
<td>Protective effect:</td>
<td>&gt; 80% (drug levels in blood plasma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 86% (95% C.I. 58-96)</td>
<td></td>
</tr>
<tr>
<td>iPrEX (MSM)</td>
<td>Peru, Ecuador, Brazil, United States, Thailand, South Africa</td>
<td>Protective effect:</td>
<td>&gt; 80% (drug levels in blood plasma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 44% (95% C.I. 15-63)</td>
<td></td>
</tr>
<tr>
<td>FEM-PrEP (Women)</td>
<td>Sub-Saharan Africa</td>
<td>No significant result - trial stopped</td>
<td>&lt; 30% (drug levels in blood plasma)</td>
</tr>
<tr>
<td>Partners PrEP Study (HIV1-serodiscordant heterosexual couples)</td>
<td>Kenya, Uganda</td>
<td>Risk reduction of HIV incidence :</td>
<td>&gt; 90% (self-reported and pill counts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• TDF arm - 67% (95% C.I. 44–81)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• TDF-FTC arm - 75% (95%C.I. 55–87)</td>
<td></td>
</tr>
<tr>
<td>TDF2/CDC 4940 Study (Men and Women)</td>
<td>Botswana</td>
<td>Overall efficacy:</td>
<td>&gt; 84 % (pill counts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 62.2% (95% C.I. 21.5–83.4)</td>
<td>&gt; 90 % (self-reported)</td>
</tr>
<tr>
<td>VOICE (MTN-003)</td>
<td>S.A., Zimbabwe, Uganda</td>
<td>Oral TDF and FTC-TDF:</td>
<td>&lt; 30% (drug levels in blood plasma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No statistically significant results</td>
<td>&gt; 88 % (self-reported)</td>
</tr>
<tr>
<td>Bangkok Tenofovir Study (IDUs)</td>
<td>Bangkok</td>
<td>Protective effect:</td>
<td>&gt; 71% (drug levels in blood plasma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 49% (95% C.I. 10-72)</td>
<td></td>
</tr>
</tbody>
</table>
### Parameter Estimates

<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Product</th>
<th>Protective Effect</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPRISA004</td>
<td>South Africa</td>
<td>Vaginal TFV 1% gel</td>
<td>39% (95% C.I. 6 – 60%)</td>
<td>&gt; 80% (self-reported)</td>
</tr>
<tr>
<td>VOICE (MTN-003)</td>
<td>S.A., Zimbabwe, Uganda</td>
<td>Tenofovir pill Truvada pill 1% tenofovir vaginal gel</td>
<td>No statistically significant results</td>
<td>Very low adherence</td>
</tr>
<tr>
<td>FACTS-001 (Women)</td>
<td>South Africa</td>
<td>Vaginal TFV 1% gel</td>
<td>No statistically significant results</td>
<td>Very low adherence</td>
</tr>
</tbody>
</table>

### Efficacy for MMC

<table>
<thead>
<tr>
<th>Source</th>
<th>Location</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auvert et. al (2005)</td>
<td>Orange Farm, S.A.</td>
<td>0.40 (0.25 - 0.70)</td>
</tr>
<tr>
<td>Grey et. al. (2007)</td>
<td>Rakai, Uganda</td>
<td>0.49 (0.30 - 0.83)</td>
</tr>
<tr>
<td>Bailey et. al. (2007)</td>
<td>Kisumu, Kenya</td>
<td>0.47 (0.28 - 0.78)</td>
</tr>
</tbody>
</table>
• Investigate
  • The current levels of HIV prevention (specifically condom use) in the US
  • The levels of acceptability of the different products by sub-populations

• A further look into behaviour change when adopting prevention methods
  • Risk compensation

• Impact of the needle exchange programs
  • Implementation of programs
PHDL Project – The way forward

### FRED in SA

Framework for Reconstructing Epidemiological Dynamics

- HIV/AIDS epidemic among adolescents and young people in South Africa
- **HIV incidence** of 2.54 in females and 0.55 in males in this age group (Shisana et al; 2014)


<table>
<thead>
<tr>
<th>Age Groups</th>
<th>HIV Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>3</td>
</tr>
<tr>
<td>15-19</td>
<td>2,5</td>
</tr>
<tr>
<td>20-24</td>
<td>1,2</td>
</tr>
<tr>
<td>20-24</td>
<td>6</td>
</tr>
<tr>
<td>21-24</td>
<td>5,1</td>
</tr>
<tr>
<td>22-24</td>
<td>5,6</td>
</tr>
</tbody>
</table>


Cape Town: HIV Prevalence per Sub District and overall: 2005 - 2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Eastern</th>
<th>Khayelitsha</th>
<th>Tygerberg</th>
<th>Tygerberg</th>
<th>Cape Town</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>11.3</td>
<td>32.5</td>
<td>13.9</td>
<td>6.4</td>
<td>7.6</td>
</tr>
<tr>
<td>2006</td>
<td>17.3</td>
<td>32.7</td>
<td>21.6</td>
<td>11.3</td>
<td>12.5</td>
</tr>
<tr>
<td>2007</td>
<td>18.3</td>
<td>31.4</td>
<td>23.3</td>
<td>11.7</td>
<td>12.4</td>
</tr>
<tr>
<td>2008</td>
<td>18.9</td>
<td>33.4</td>
<td>22.4</td>
<td>13.9</td>
<td>9.9</td>
</tr>
<tr>
<td>2009</td>
<td>16.8</td>
<td>30.1</td>
<td>24.0</td>
<td>13.9</td>
<td>11.9</td>
</tr>
<tr>
<td>2010</td>
<td>18.4</td>
<td>33.1</td>
<td>23.4</td>
<td>13.3</td>
<td>12.1</td>
</tr>
</tbody>
</table>

PHDL Project – Acknowledgements

Thank you!

- Sharon Crow
- Molly Eggleston
- Faculty and students at the PHDL
- Benter Foundation