Is HIV incidence going down?

Southern African HIV Clinicians Society Conference
26 September 2014, Cape Town

Salim S Abdool Karim

Director: CAPRISA
Chair: UNAIDS Scientific Expert Panel
Pro Vice-Chancellor (Research): University of KwaZulu-Natal
Professor in Clinical Epidemiology, Columbia University
Adjunct Professor of Medicine, Cornell University
Associate Member, Ragon Institute of MGH, MIT and Harvard
Overview

• What is incidence?
• Global HIV prevalence and incidence
• Estimating / Extrapolating HIV incidence
  1. Using mathematical models on HIV prevalence data from cross-sectional studies
  2. Laboratory methods to identify recent HIV infection
• Measuring HIV incidence through follow-up
• Trends in national HIV incidence estimates in SA
• Conclusion
What is incidence?

• **Incidence rate**: number of new cases per population at risk in a given time period

• **Prevalence**: proportion of a population found to have a condition

Or

• **Prevalence**: “*What proportion of people have HIV right now?*” (snapshot)

• **Incidence**: "*How many people have newly acquired HIV in one year?*“ (movie)
Global number of adults living with HIV & new HIV infections

Source: UNAIDS Global Report 2014

Estimated number of people living with HIV (Millions)

Prevalence

Incidence

Number of new HIV infections (Millions)
Estimating HIV incidence: Using mathematical models on HIV prevalence data from cross-sectional studies

**Estimating incidence from age-specific prevalence for irreversible diseases with differential mortality**

Marvin J. Podgor¹ and M. Cristina Leske²

Statistical models for estimating incidence from differences in HIV prevalence in age-specific strata
- Only need one cross-sectional study across ages
- Relatively simple mathematical approach
- *Podger & Leske* method allows for differential mortality between people with & without disease.…

**Estimating HIV incidence rates from age prevalence data in epidemic situations**

Brian Williams¹,*,†, Eleanor Gouws², David Wilkinson³ and Salim Abdool Karim²

Extrapolating incidence from temporal trends in age-specific prevalence rates
- Needs repeat prevalence studies in same population
- Assumes constant mortality over time
Estimating HIV incidence:
Using mathematical models on HIV prevalence data from cross-sectional studies

Dynamical models, use data on time trends in age-specific prevalence of HIV infection
• makes assumptions about age dependence and survivorship function for HIV infected people

Demographic approaches to the estimation of incidence of HIV-1 infection among adults from age-specific prevalence data in stable endemic conditions.
Gregson, Simon; Donnelly, Christl A.; Parker, Gareth C.; Anderson, Roy M.

Demographic models, mostly investigate the demographic consequences of HIV - for use in life insurance, health and pension applications
Estimating HIV incidence:
Estimating HIV incidence using laboratory methods

Natural Course of HIV Infection

Assays for HIV infection before the presence of HIV antibodies
- p24 antigen assay
- Nucleic acid amplification

A comparison of three methods for detection of antibodies against the major core protein p24 of human immunodeficiency virus.
Lindhardt BO, Pedersen C, Ulrich K, Kusk P
Estimating HIV Incidence from window period prevalence

Let \((t_1, t_2)\) be the distribution of times individuals take to reach the detection thresholds of the 2 assays.

\[
R = \int_{-t_2^{max}}^{0} \int_{0}^{-t} \int_{-t}^{t_1^{max}} i(t) N_s(t) \rho(t_1, t_2) \, dt_2 \, dt_1 \, dt \quad (2)
\]

Source: Welte A & Abdool Karim SS. CHAVI presentation
Estimating HIV incidence:
Using laboratory methods to identify recent HIV infection

High Incidence if HIV-1 in South Africa Using a Standardised Algorithm for Recent HIV Seroconversion
*Eleanor Gouws, †Brian G. Williams, ‡Haynes W. Sheppard, ††Barryett Enge, and *Salim Abdool Karim

Performance Characteristics of the Immunoglobulin G-Capture BED-Enzyme Immunoassay, an Assay To Detect Recent Human Immunodeficiency Virus Type 1 Seroconversion
Trudy Dobbs, Susan Kennedy, Chou-Pong Pau, J. Steven McDougal, and Bharat S. Parekh*

Detection of Recent HIV-1 Infection Using a New Limiting-Antigen Avidity Assay: Potential for HIV-1 Incidence Estimates and Avidity Maturation Studies
Yen T. Duong, Maofeng Qiu*, Anindya K. De, Keisha Jackson, Trudy Dobbs, Andrea A. Kim, John N. Nkengasong, Bharat S. Parekh*
# Measuring actual HIV incidence rates: Cohort studies in KwaZulu-Natal

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>HIV Incidence (per 100 person years) (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-4</td>
<td>Durban:</td>
<td>5.3 (2.7 - 9.2), Hlabisa: 6.2 (3.4 - 10.5)</td>
</tr>
<tr>
<td>2002-5</td>
<td>Rural KZN:</td>
<td>6.6</td>
</tr>
<tr>
<td>2004-7</td>
<td>Rural:</td>
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<td>2004-7</td>
<td>Urban:</td>
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<tr>
<td>2002-5</td>
<td>Rural KZN:</td>
<td>6.5 (4.6–8.9)</td>
</tr>
</tbody>
</table>

## The Value of Site Preparedness Studies for Future Implementation of Phase 2/IIb/III HIV Prevention Trials

*Experience From the HPTN 055 Study*

**Gita Ramjee, PhD,* Saidi Kapiga, MD, MPH, ScD,† Stephen Weiss, PhD, MPH,‡ Leigh Peterson, PhD,§ Corey Leburg, MHS,¶ Cliff Kelly, MS,** Benoît Masse, PhD,** and the HPTN 055 Study Team*

## HIV Incidence Among Non-Pregnant Women Living in Selected Rural, Semi-Rural and Urban Areas in Kwazulu-Natal, South Africa

**Gita Ramjee • Handan Wand • Claire Whitaker • Sheena McCormack • Nancy Padian • Cliff Kelly • Andrew Nunn**

## Stabilizing HIV prevalence masks high HIV incidence rates amongst rural and urban women in KwaZulu-Natal, South Africa

**Quarrainsha Abdool Karim,**| Ayesha BM Kharsany,†· Janet A Frohlich,‡ Lise Werner,¶ May Mashegu,§ Mukelisiwe Mlotshwa,¶ Bernadette T Madlala,¶ Feakelishwane Ntombela and Salim S Abdool Karim

## HIV Incidence in Young Girls in KwaZulu-Natal, South Africa-Public Health Imperative for Their Inclusion in HIV Biomedical Intervention Trials

**Quarrainsha Abdool Karim • Ayesha B. M. Kharsany • Janet A. Frohlich • Lise Werner • Mukelisiwe Mlotshwa • Bernadette T. Madlala • Salim S. Abdool Karim**
## Measuring actual HIV incidence rates: Cohort studies continued....

<table>
<thead>
<tr>
<th>Year</th>
<th>Study Title</th>
<th>Location</th>
<th>HIV Incidence (per 100 person years) (95%CI)</th>
</tr>
</thead>
</table>
| 2007-8 | HIV Prevalence and Incidence among Sexually Active Females in Two Districts of South Africa to Determine Microbicide Trial Feasibility | North West: 6.0 (3.0-9.0)  
Western Cape: 4.5 (1.8, 7.1) |                                                         |
Edendale: 6.3 (3.2-9.4)  
Pinetown: 7.2 (3.7-10.7) |                                                         |
| 2009 | HIV incidence and prevalence among cohorts of women with higher risk behaviour in Bloemfontein and Rustenburg, South Africa: a prospective study | Bloemfontein: 5.5 (2.5-10.4)  
Rustenberg: 3.0 (0.4-10.8) |                                                         |

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1. Measuring actual HIV incidence rates: Cohort studies continued....

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**References**

1. Paul J Feldblum, Mary H Latka, Johann Lombaard, Candice Chetty, Pai-Lien Chen, Connie Sexton, Shelly Fischer
Extrapolated HIV incidence for SA: National trends by age and sex

HSRC estimates of HIV incidence over the last decade

Extrapolated HIV incidence for SA: National trends by age and sex

Extrapolated HIV incidence for SA: National trends by age and sex

One of every 3 HIV infections in young women occurs in SA
Conclusion

• Incidence rate is key measure of HIV prevention programme outcome – real time estimate of impact

• Many ways to extrapolate & estimate incidence

• Actual measurement of incidence in cohorts important but expensive, difficult and not national

• Cohort measured HIV incidence: some decline but ongoing high HIV incidence in young women

• Extrapolations from national seroprevalence surveys: minimal decline overall with decline in young women offset by increases in older women

• Regardless of measurement method or trends preferred – SA has a major ongoing challenge of high HIV incidence, esp in women