



CAPRISA

CENTRE FOR THE AIDS PROGRAMME OF RESEARCH IN SOUTH AFRICA



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COLLABORATING CENTRE FOR
HIV RESEARCH AND POLICY

Is HIV incidence going down?

Southern African HIV Clinicians Society Conference
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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**

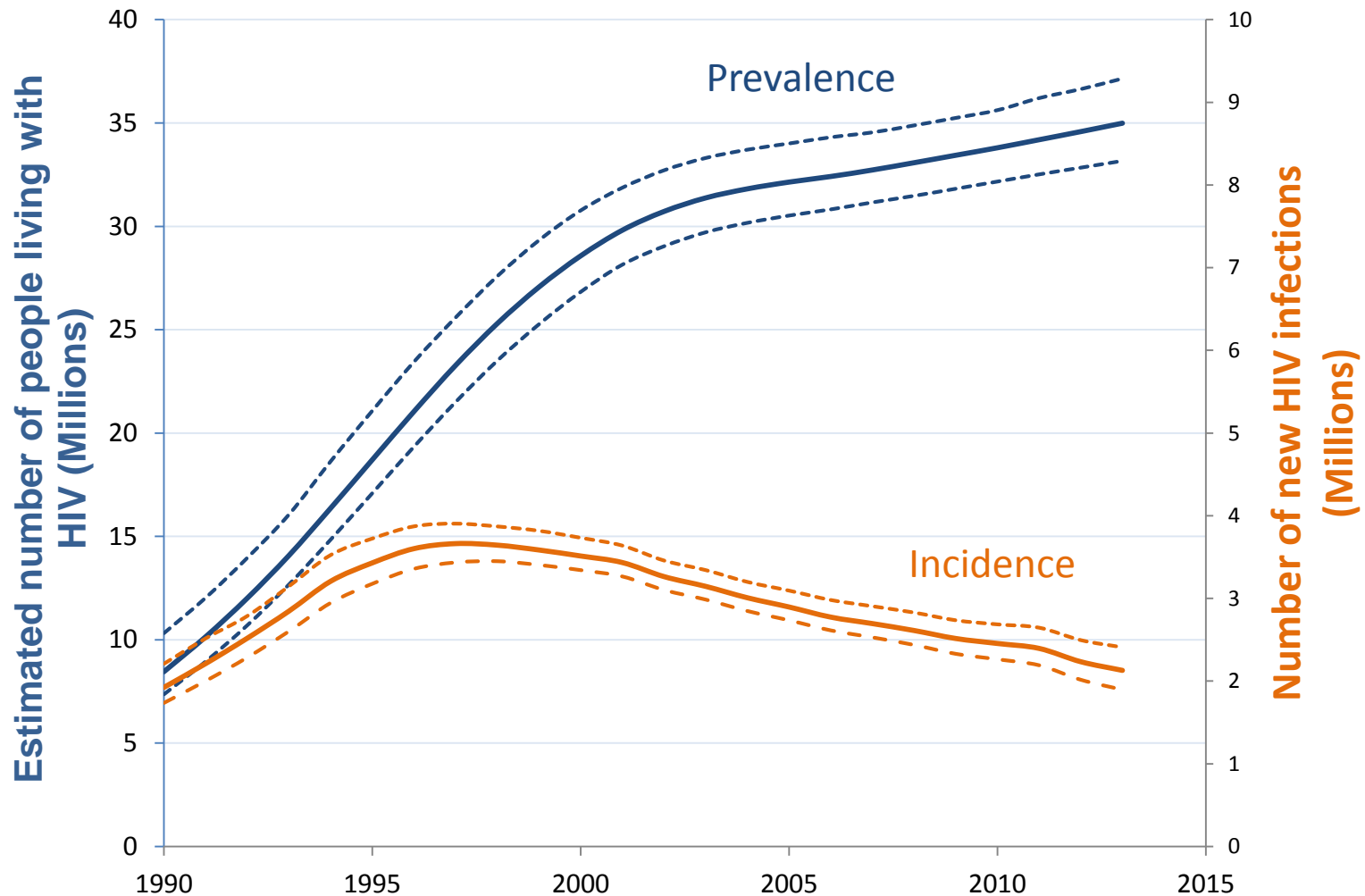
What is incidence?

- **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

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 Williams^{1,*,\dagger}, 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



Validation of a Method to Estimate Age-specific Human Immunodeficiency Virus (HIV) Incidence Rates in Developing Countries Using Population-based Seroprevalence Data

T. Saidel,¹ D. Sokal,² J. Rice,³ T. Buzingo,⁴ and S. Hassig¹

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



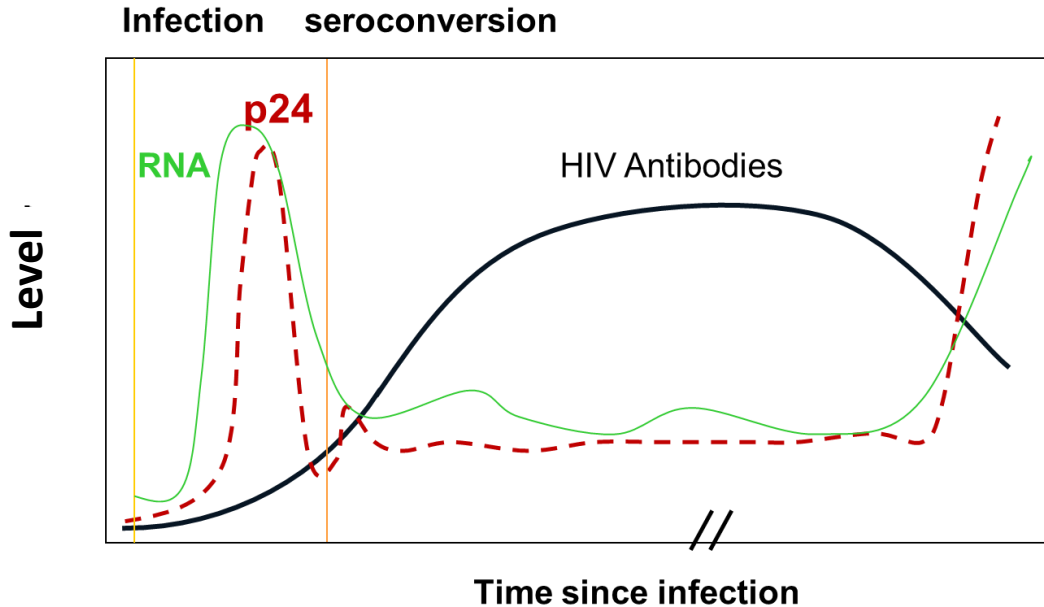
Demographic approaches to the estimation of incidence of HIV-1 infection among adults from age-specific prevalence data in stable endemic conditions.

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

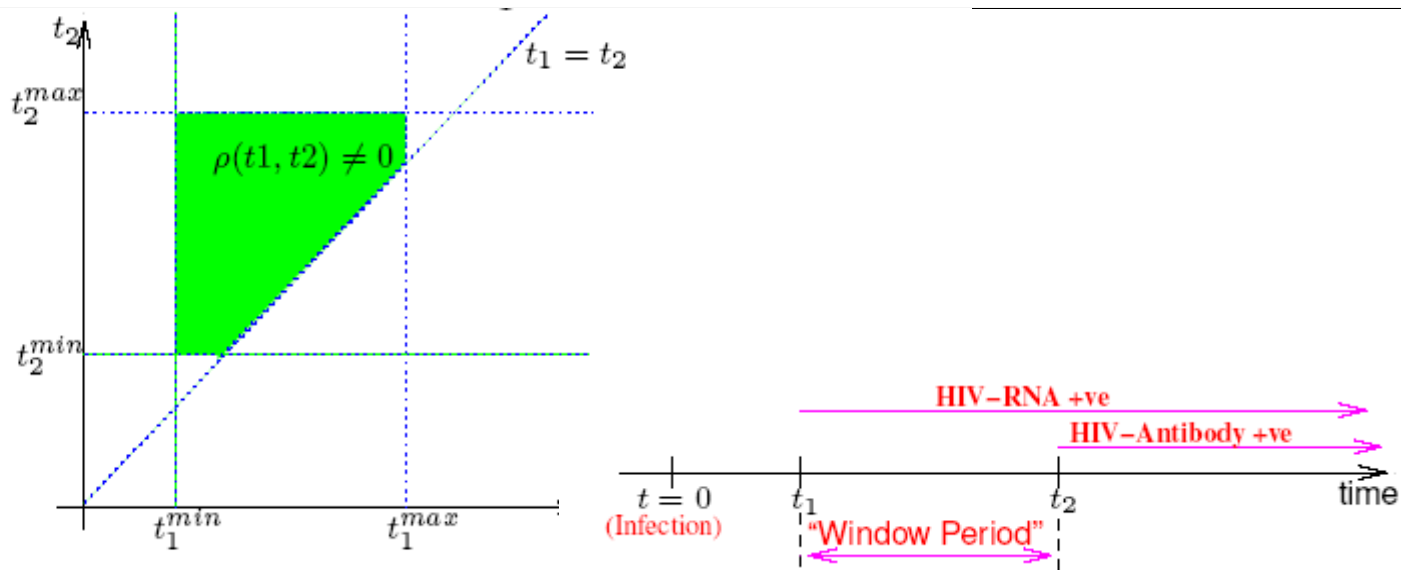


A comparison of three methods for detection of antibodies against the major core protein p24 of human immunodeficiency virus.

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



$$R = \int_{-t_2^{max}}^0 \int_0^{-t} \int_{-t}^{t_2^{max}} i(t) N_s(t) \rho(t_1, t_2) dt_2 dt_1 dt \quad (2)$$

Estimating HIV incidence:

Using laboratory methods to identify recent HIV infection



High Incidence of 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

**Sensitive/
less sensitive
assay**



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*

**IgG-capture
BED EIA**



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*

Avidity index

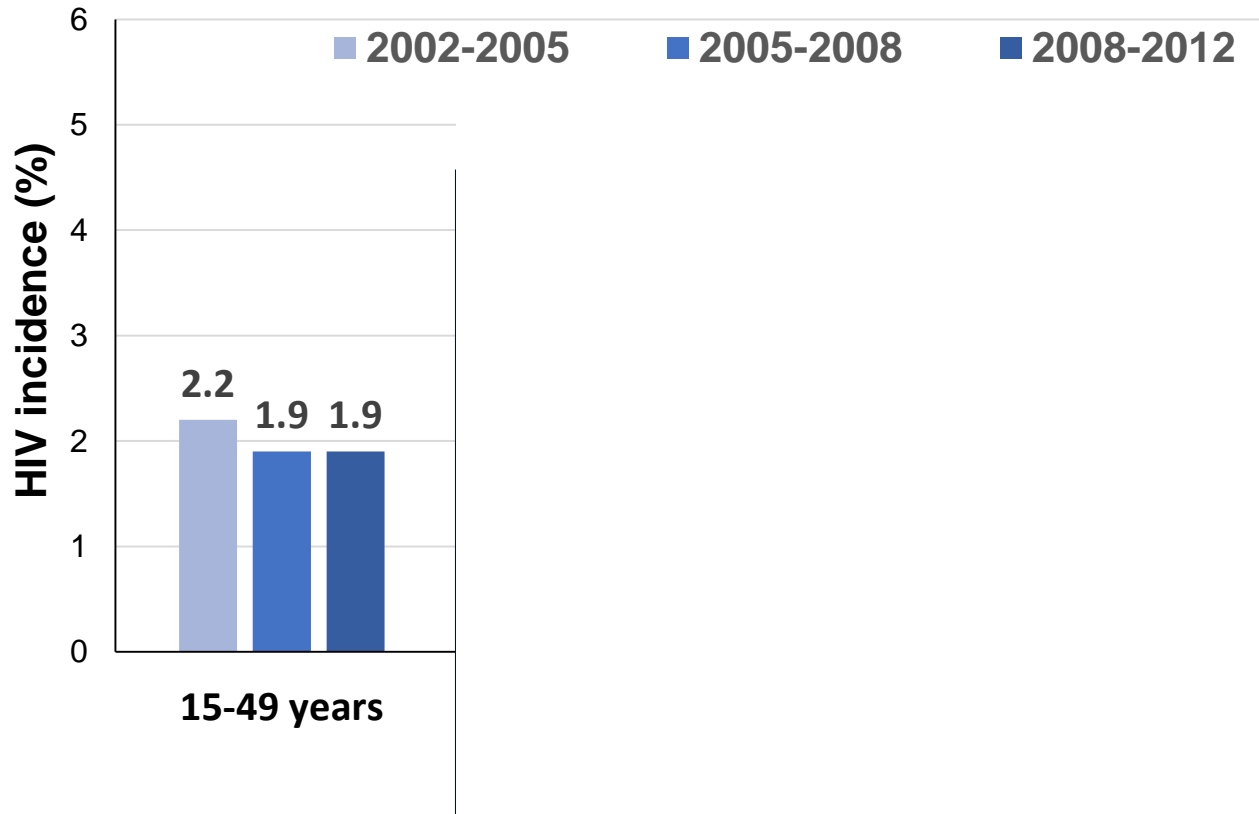
Measuring actual HIV incidence rates: Cohort studies in KwaZulu-Natal

	HIV incidence (per 100 person years) (95%CI)
<p>2003-4</p> <p>The Value of Site Preparedness Studies for Future Implementation of Phase 2/IIb/III HIV Prevention Trials <i>Experience From the HPTN 055 Study</i></p> <p><i>Gita Ramjee, PhD,* Saidi Kapiga, MD, MPH, ScD,† Stephen Weiss, PhD, MPH,‡ Leigh Peterson, PhD,§ Corey Leburg, MHS, Cliff Kelly, MS, Benoit Masse, PhD, and the HPTN 055 Study Team</i></p>	<p><i>Durban: 5.3 (2.7 - 9.2), Hlabisa: 6.2 (3.4 - 10.5)</i></p>
<p>2002-5</p> <p>HIV Incidence Among Non-Pregnant Women Living in Selected Rural, Semi-Rural and Urban Areas in Kwazulu-Natal, South Africa</p> <p>Gita Ramjee · Handan Wand · Claire Whitaker · Sheena McCormack · Nancy Padian · Cliff Kelly · Andrew Nunn</p>	<p><i>Rural KZN: 6.6</i></p>
<p>2004-7</p> <p>Stabilizing HIV prevalence masks high HIV incidence rates amongst rural and urban women in KwaZulu-Natal, South Africa</p> <p><small>Quarraisha Abdool Karim,^{1,2} Ayesha BM Kharsany,^{1*} Janet A Frohlich,¹ Lise Werner,¹ May Mashego,¹ Mukelisiwe Mlotshwa,¹ Bernadette T Madlala,¹ Fanelesibonge Ntombela¹ and Salim S Abdool Karim^{1,2}</small></p>	<p><i>Rural: 6.5 (4.4–9.2) Urban: 6.4 (2.6–13.2)</i></p>
<p>2004-7</p> <p>HIV Incidence in Young Girls in KwaZulu-Natal, South Africa-Public Health Imperative for Their Inclusion in HIV Biomedical Intervention Trials</p> <p>Quarraisha Abdool Karim · Ayesha B. M. Kharsany · Janet A. Frohlich · Lise Werner · Mukelisiwe Mlotshwa · Bernadette T. Madlala · Salim S. Abdool Karim</p>	<p><i>Rural KZN: 6.5 (4.6–8.9)</i></p>

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

		HIV incidence (per 100 person years) (95%CI)
2007-8	<p>HIV Prevalence and Incidence among Sexually Active Females in Two Districts of South Africa to Determine Microbicide Trial Feasibility</p> <p>Annaléne Nel¹, Cheryl Louw², Elizabeth Hellstrom³, Sarah L. Braunstein⁴, Ina Treadwell³, Melanie Marais³, Martie de Villiers², Jannie Hugo², Inge Paschke³, Chrisna Andersen³, Janneke van de Wijgert^{5*}</p>	<p><i>North West: 6.0</i> (3.0-9.0) <i>Western Cape: 4.5</i> (1.8, 7.1)</p>
2007-9	<p>HIV Incidence Remains High in KwaZulu-Natal, South Africa: Evidence from Three Districts</p> <p>Annaléne Nel¹, Zonke Mabude^{2,8}, Jenni Smit^{2,8}, Philip Kotze³, Derek Arbuckle⁴, Jian Wu⁵, Neliëtte van Niekerk⁶, Janneke van de Wijgert^{7*}</p>	<p><i>Ladysmith: 14.8</i> (9.7-19.8) <i>Edendale: 6.3</i> (3.2-9.4) <i>Pinetown: 7.2</i> (3.7-10.7)</p>
2009	<p>HIV incidence and prevalence among cohorts of women with higher risk behaviour in Bloemfontein and Rustenburg, South Africa: a prospective study</p> <p>Paul J Feldblum,¹ Mary H Latka,² Johann Lombaard,³ Candice Chetty,² Pai-Lien Chen,¹ Connie Sexton,^{1,*} Shelly Fischer¹</p>	<p><i>Bloemfontein: 5.5</i> (2.5-10.4) <i>Rustenberg: 3.0</i> (0.4-10.8)</p>

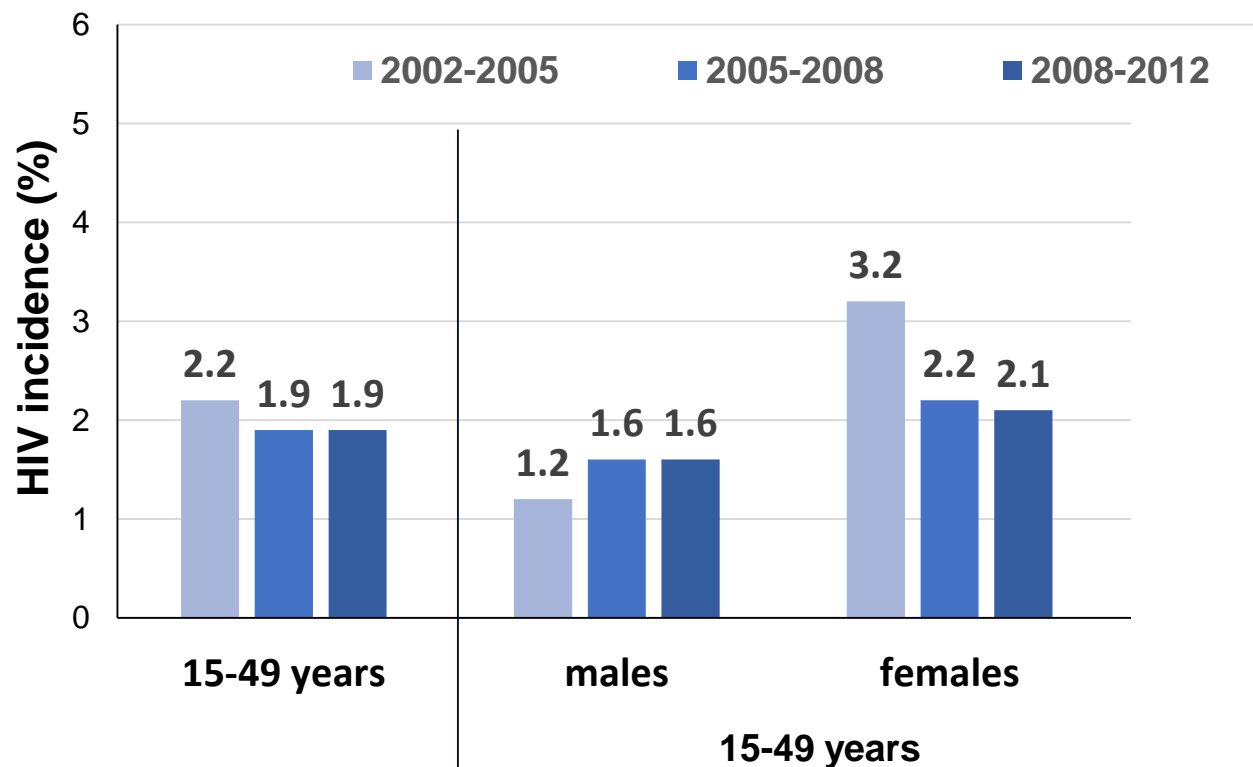
Extrapolated HIV incidence for SA: National trends by age and sex



HSRC estimates of HIV incidence over the last decade

Source: Shisana, O, et al (2014) *South African National HIV Prevalence, Incidence and Behaviour Survey, 2012*. Cape Town, HSRC Press.

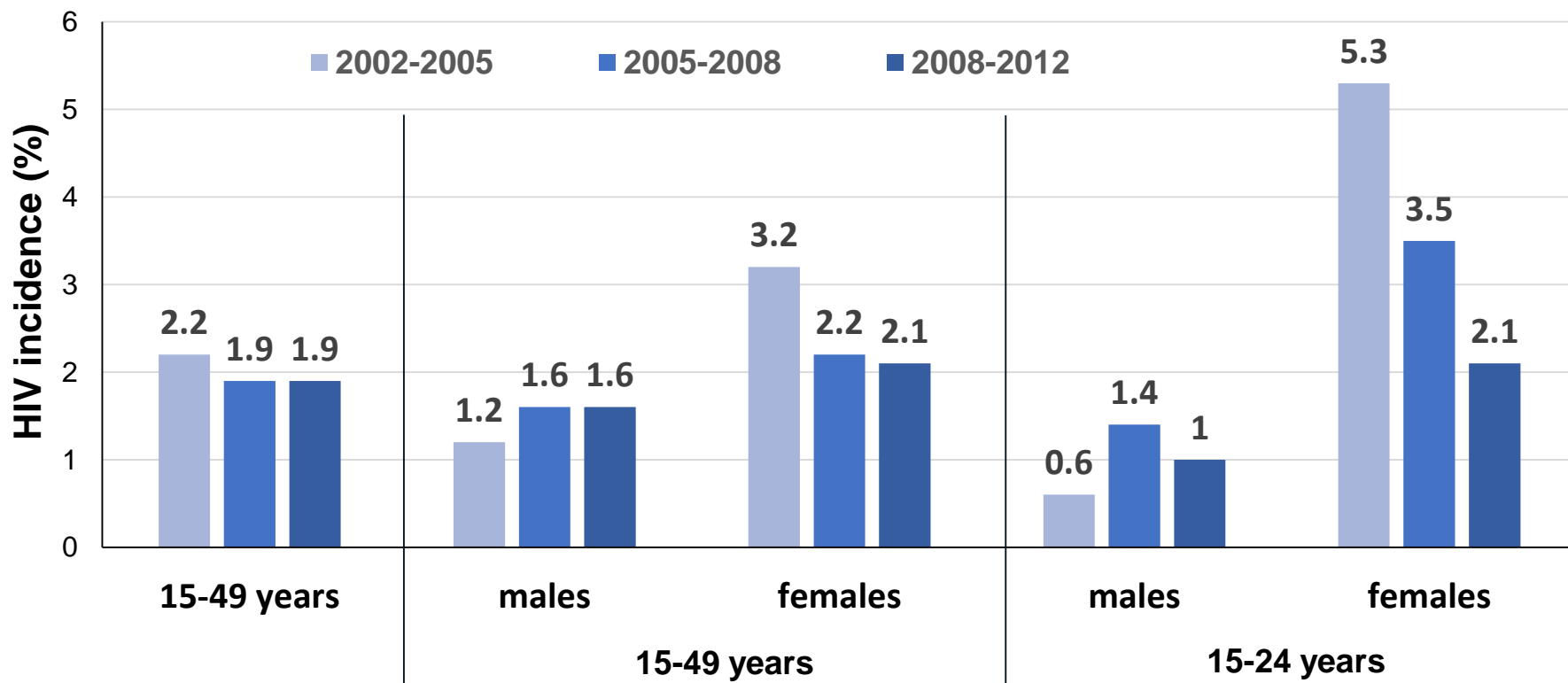
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HSRC estimates of HIV incidence over the last decade

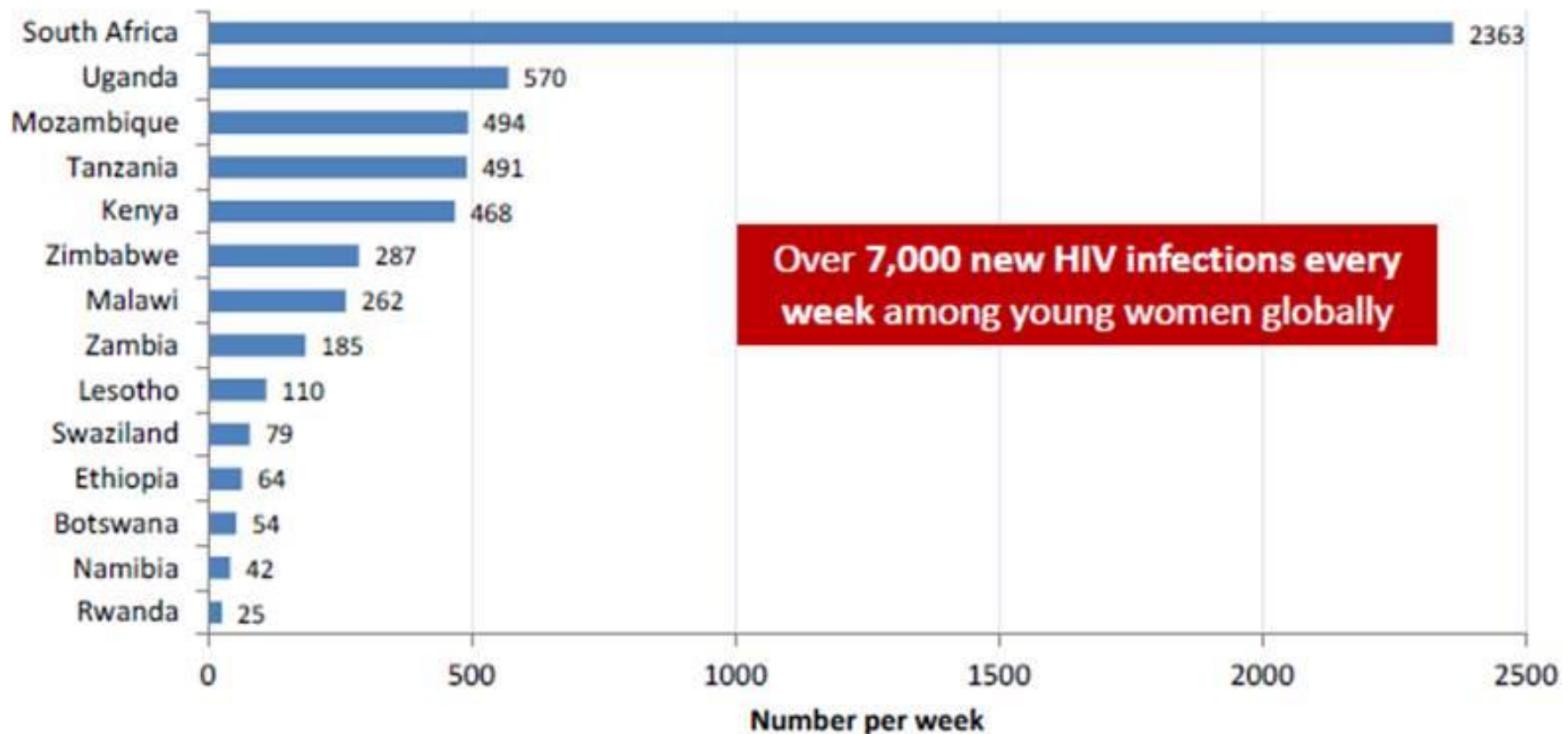
Source: Shisana, O, et al (2014) *South African National HIV Prevalence, Incidence and Behaviour Survey, 2012*. Cape Town, HSRC Press.

HIV Incidence among Young Women

More than 1/3 New HIV Infections Globally Occur among Young Women in Africa

Estimated number of new HIV infections *per week* among young women aged 15-24 years in East and Southern Africa, 2012

Data source: UNAIDS 2013



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**