Second generation HIV surveillance: Better data for decision making

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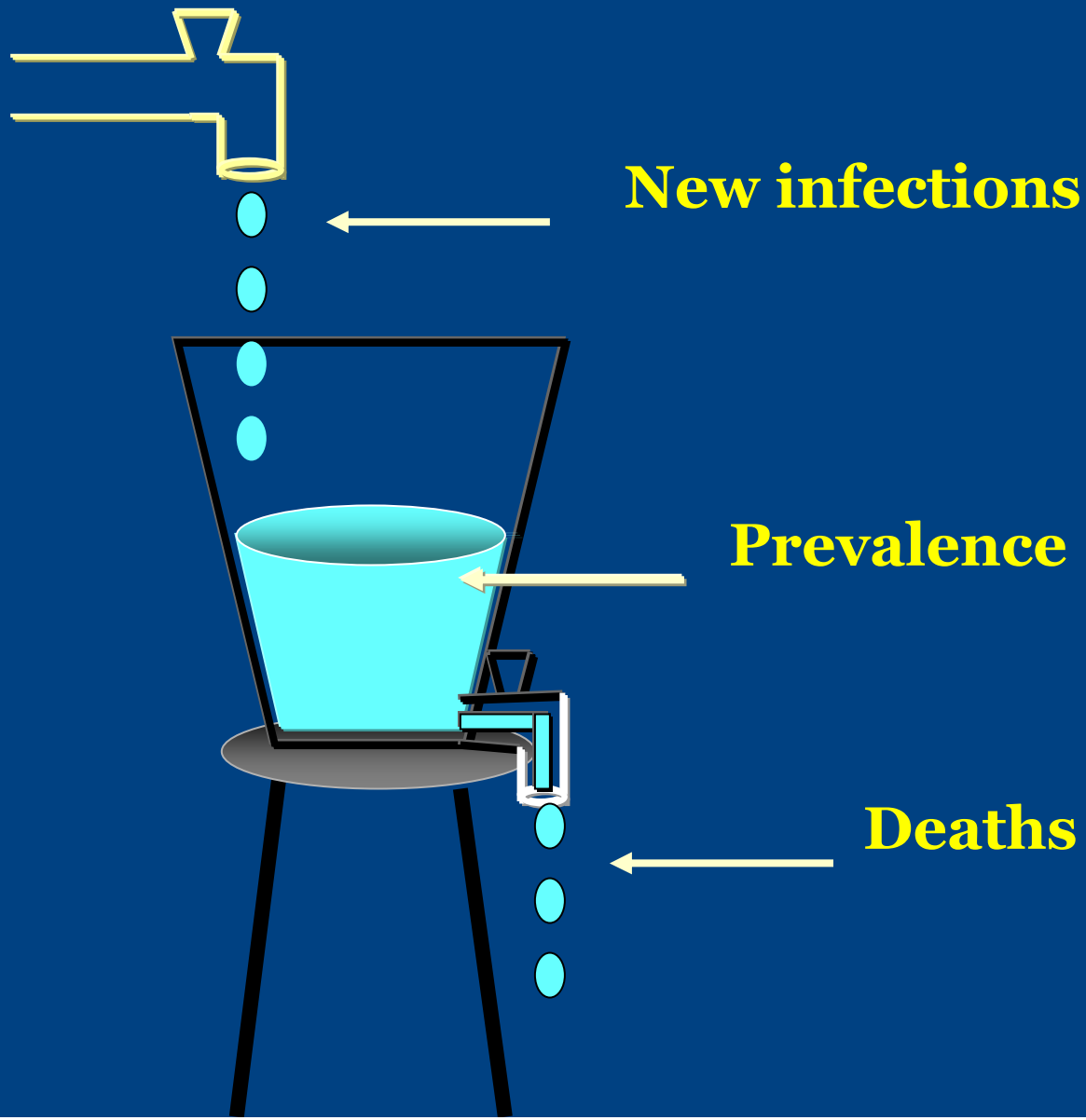
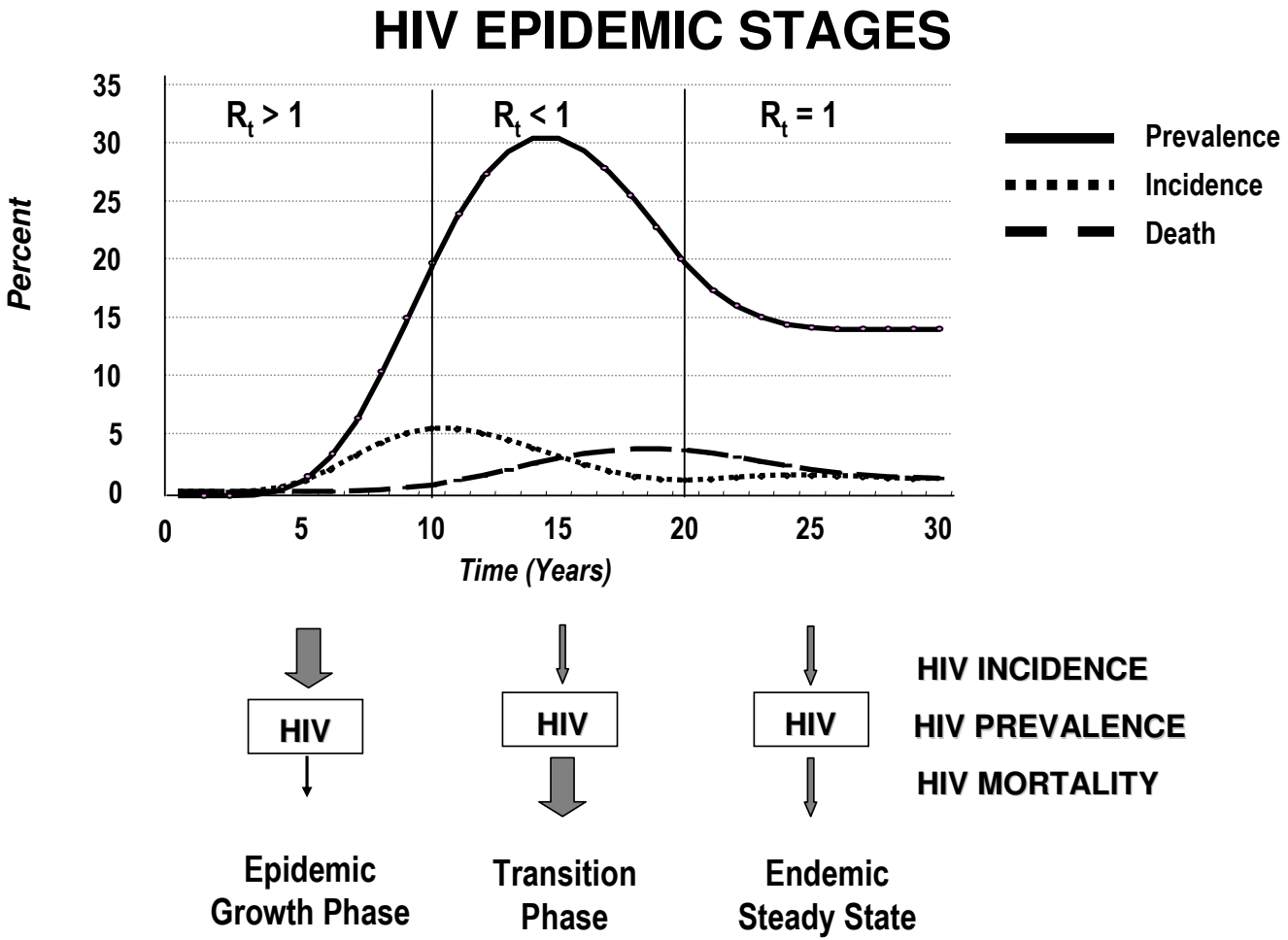
If it was so easy…



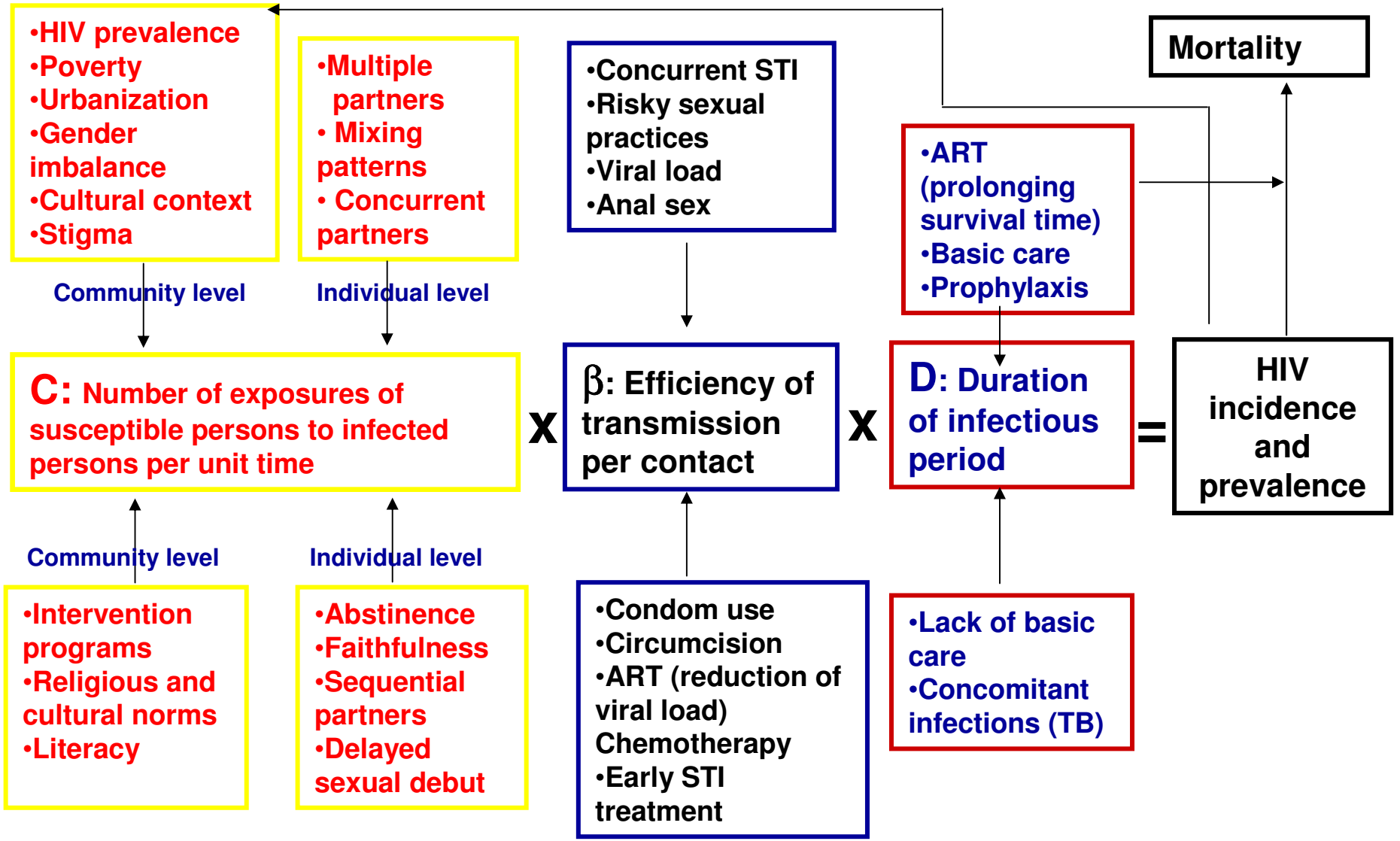
Relationship between incidence, prevalence, and mortality



Source: FHI Evaluation Handbook 2001

Basic reproductive rate R_o of HIV infection

Factors potentially facilitating HIV spread



Factors potentially reducing HIV spread

Data for Improved Analysis and Decision Making

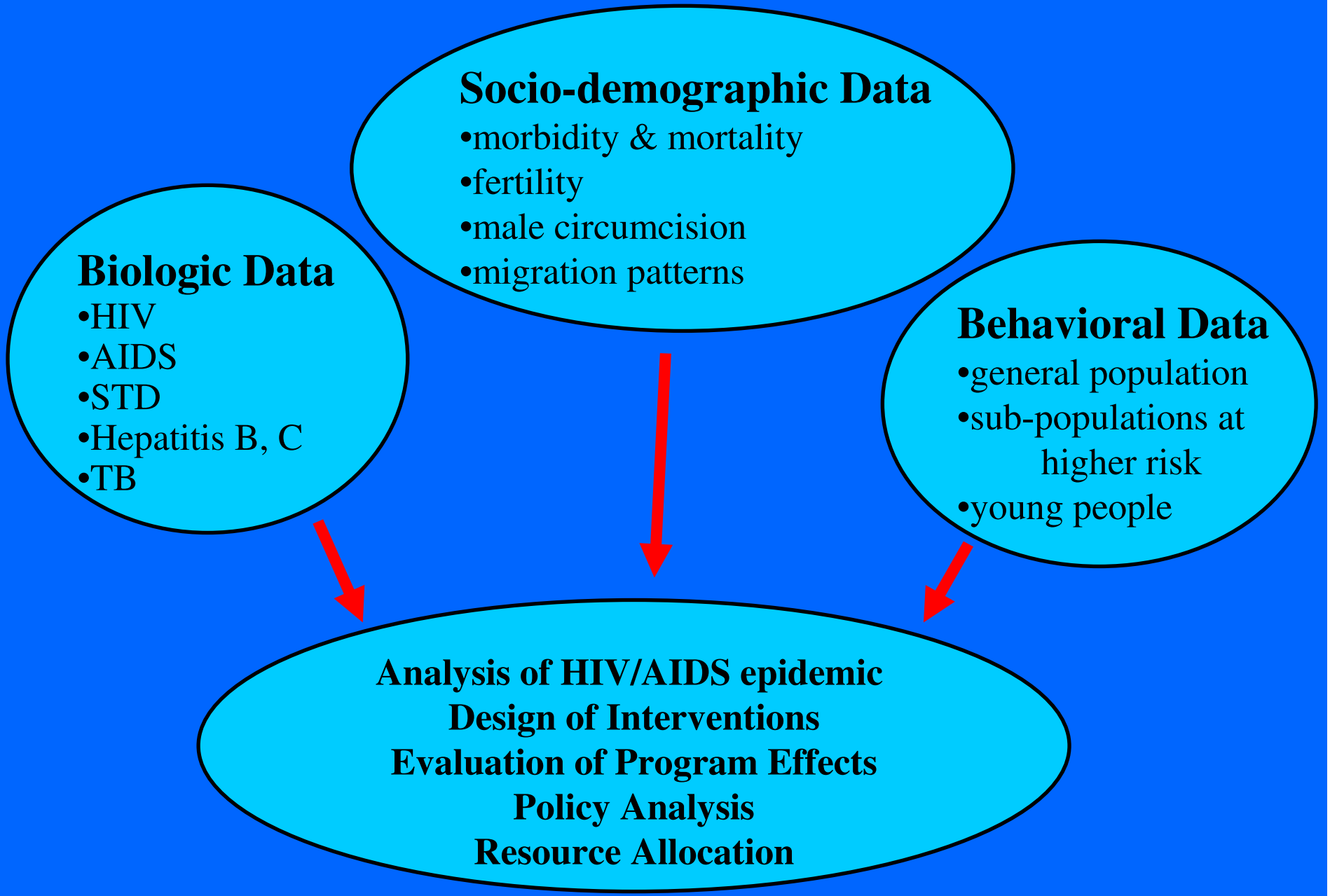
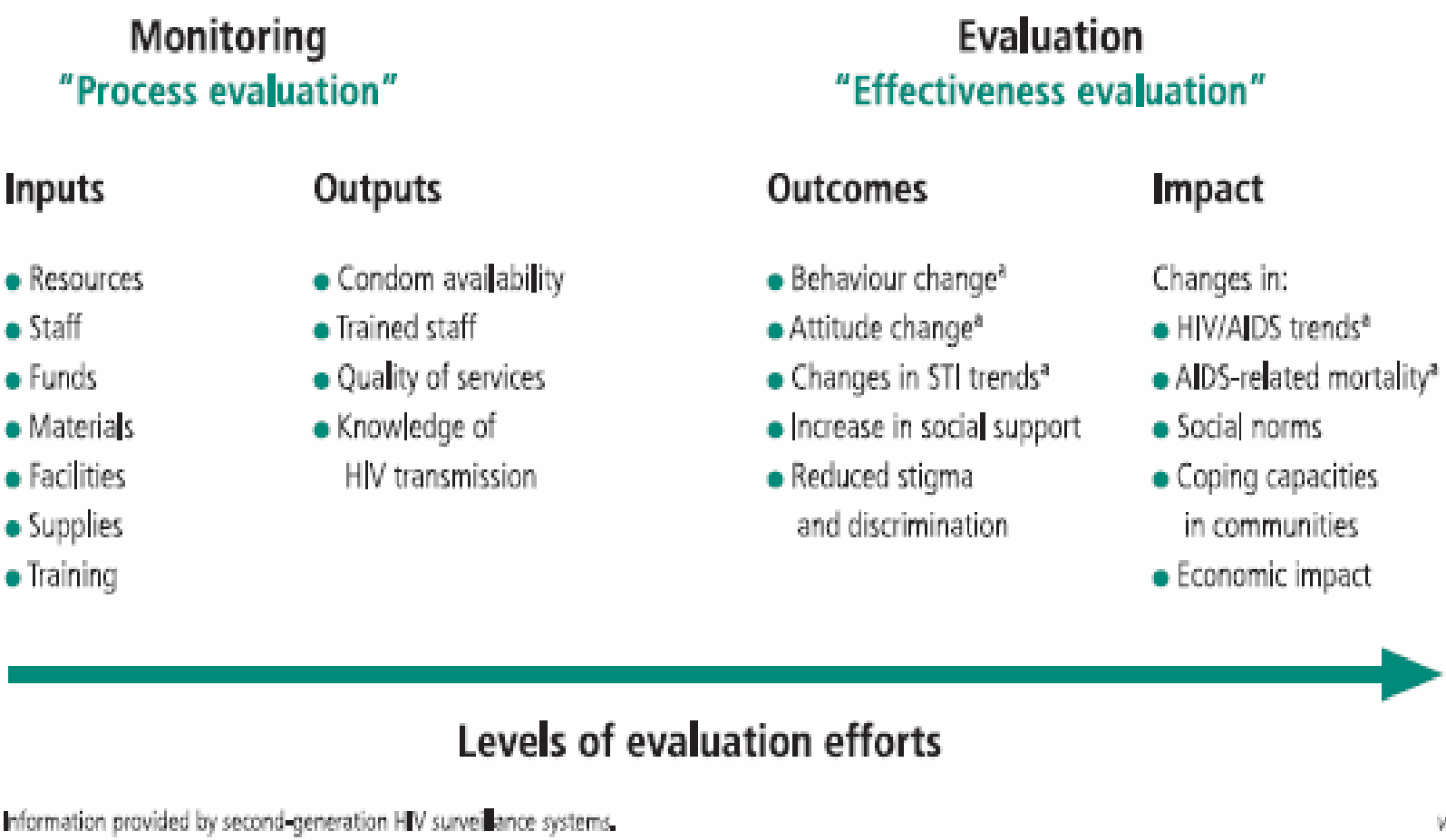


Fig. 2. **Framework of monitoring and evaluation efforts**



* Information provided by second-generation HIV surveillance systems.

WHO 04.2

Critical Questions

Are the observed changes in HIV trends:

1. **a reflection of the natural history of the epidemic?**
2. **a product of changes in behavior?**
3. **a product of interventions?**

Factors Contributing to Observed Changes in HIV Prevalence

- Mortality, especially in mature epidemics
- Decrease in new HIV infections as a result of behavior change:
  - Effect of interventions
  - Spontaneous (e.g. close friend with HIV/AIDS)
- Population differentials related to in- and out migration patterns
- Sampling bias and/or errors in data collection

Expected increase in HIV Prevalence due to:

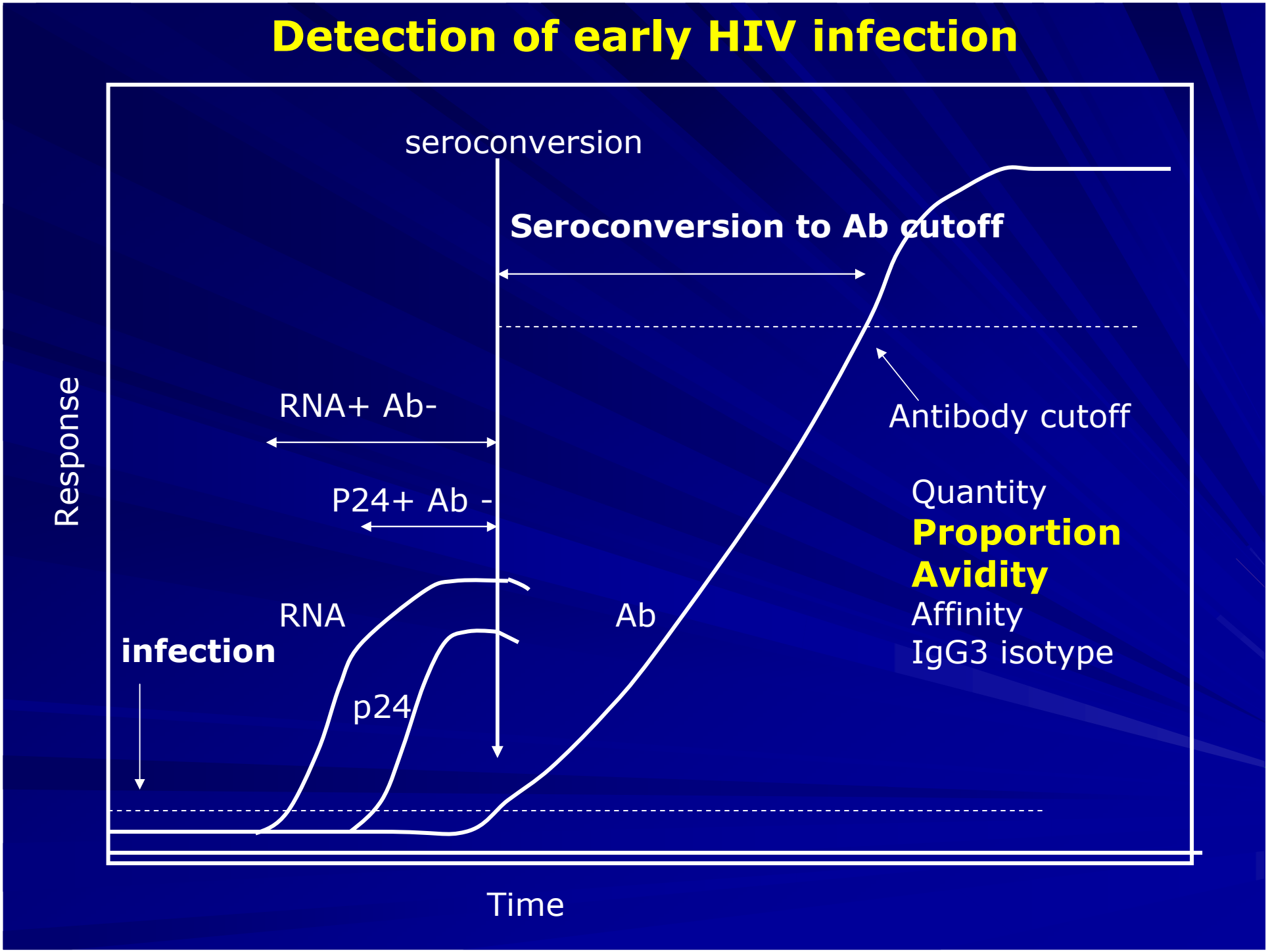
- Decrease in deaths in HIV infected persons as a result of antiretroviral therapy (ART)

Estimating national HIV incidence

- **Epidemiological methods**
  - **Cohort studies *(directly observed incidence)***
  - **HIV prevalence in youngest age group**
    (as a proxy for recent infection)
  - **Mathematical modeling *(indirect incidence estimate)***

- **Laboratory- based methods**
  (direct incidence measure from cross-sectional surveys)

Detection of early HIV infection



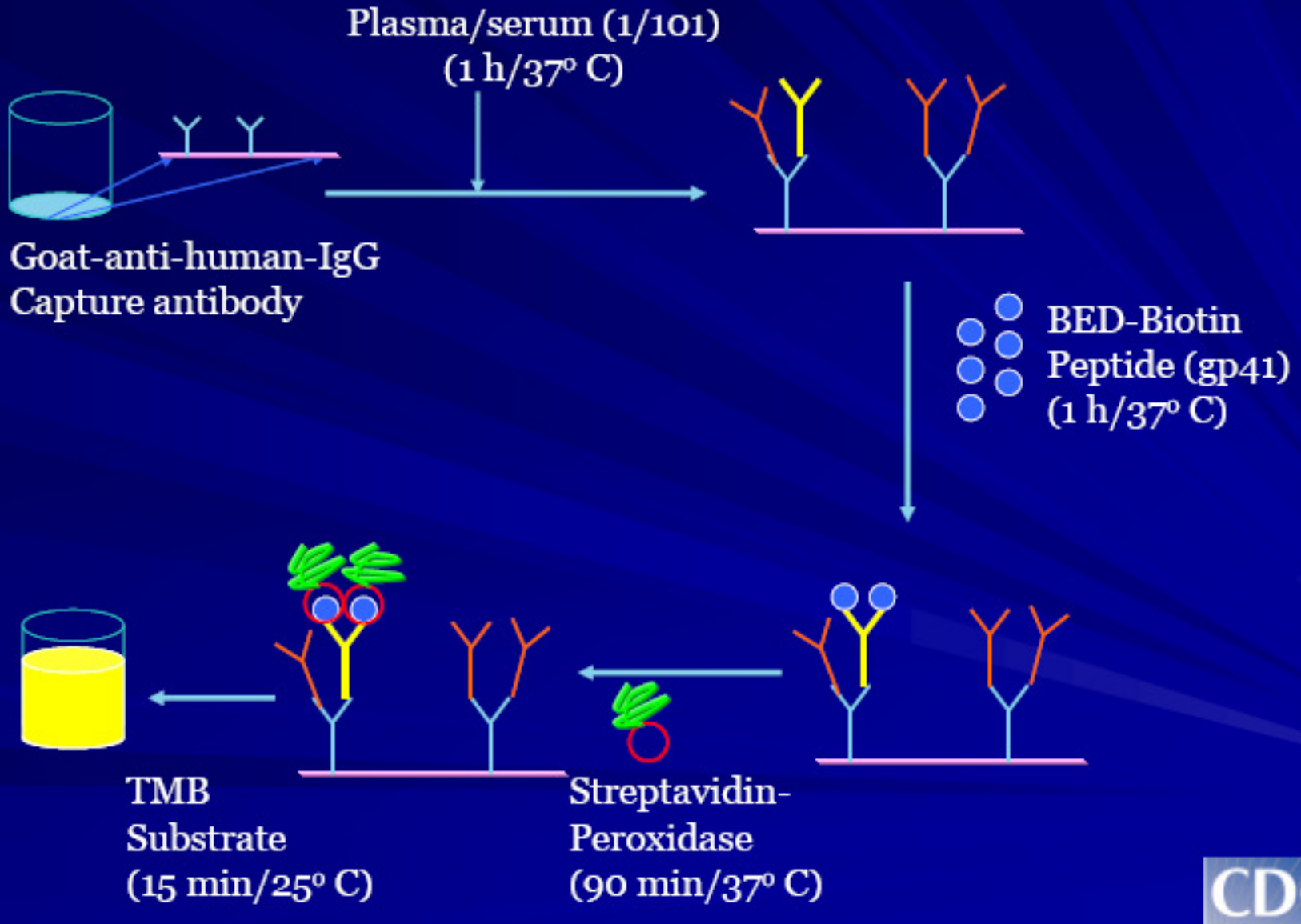
Limitations of existing assays

- Some overestimate HIV incidence due to misclassification of long-term infections as recent
- Some remain to be evaluated in larger samples with diverse HIV-1 subtypes
- Some have no HIV incidence formulas established
- In-house assays may not be reproducible

Adjusting HIV incidence estimates

- **Case-based surveillance**
  - using HIV-testing and ART history
  - Not feasible in many resource-poor settings
- **Formula-based adjustments**
  - More data needed to account for ART-related misclassification and appropriate adjustments
- **Laboratory based adjustment**
  - Sequential testing algorithm (not yet validated)

Schematic of the BED-CEIA

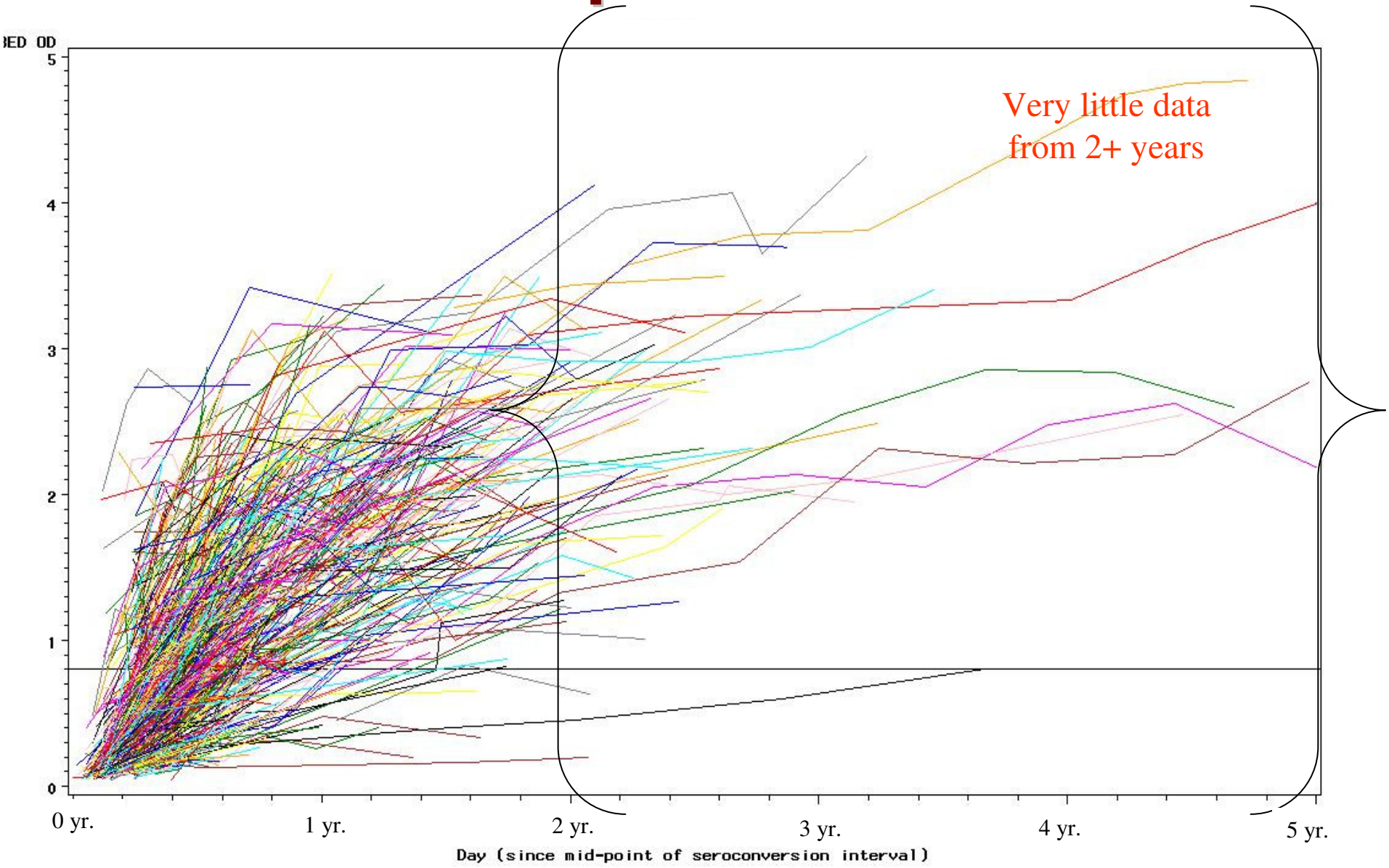


BED window periods at 0.8 cutoff

Subtypes	Country	Window (95% CI)
AD	Kenya	171 (150-199)
B	Amsterdam	127 (113-152)
B	Thailand	143 (118-170)
C	**Zimbabwe**	**181 (165-198)**
C	Ethiopia	167 (154-180)
E	Thailand	115 (106-125)

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

BED OD values over time in seroconverter panels



BED incidence adjustments

- **BED validation meeting, CDC 2006:**
  - **Sensitivity/Specificity Adjustment (McDougal et al.)**
  - **Specificity Adjustment (Hargrove et al.)**
  - **Validated for HIV-1 subtypes B and C (2 532 specimens from 1 192 individuals)**

National HIV Household Survey South Africa 2005

- First national survey with HIV incidence testing
- Study population: 2 years and older
- Anonymous HIV testing of dried blood spot specimens
- Final sample: 23 275 interviewed, 15 851 tested for HIV

BED HIV incidence calculation

$$I = \frac{F\,(365/w)\,N_{inc}}{N_{neg} + F\,(365/w)\,N_{inc}/2} \times 100$$

$$\text{Adjustment Factor (McDougal)} = \frac{(R/P) + \gamma - 1}{(R/P)\,(\alpha - \beta + 2\gamma - 1)}$$

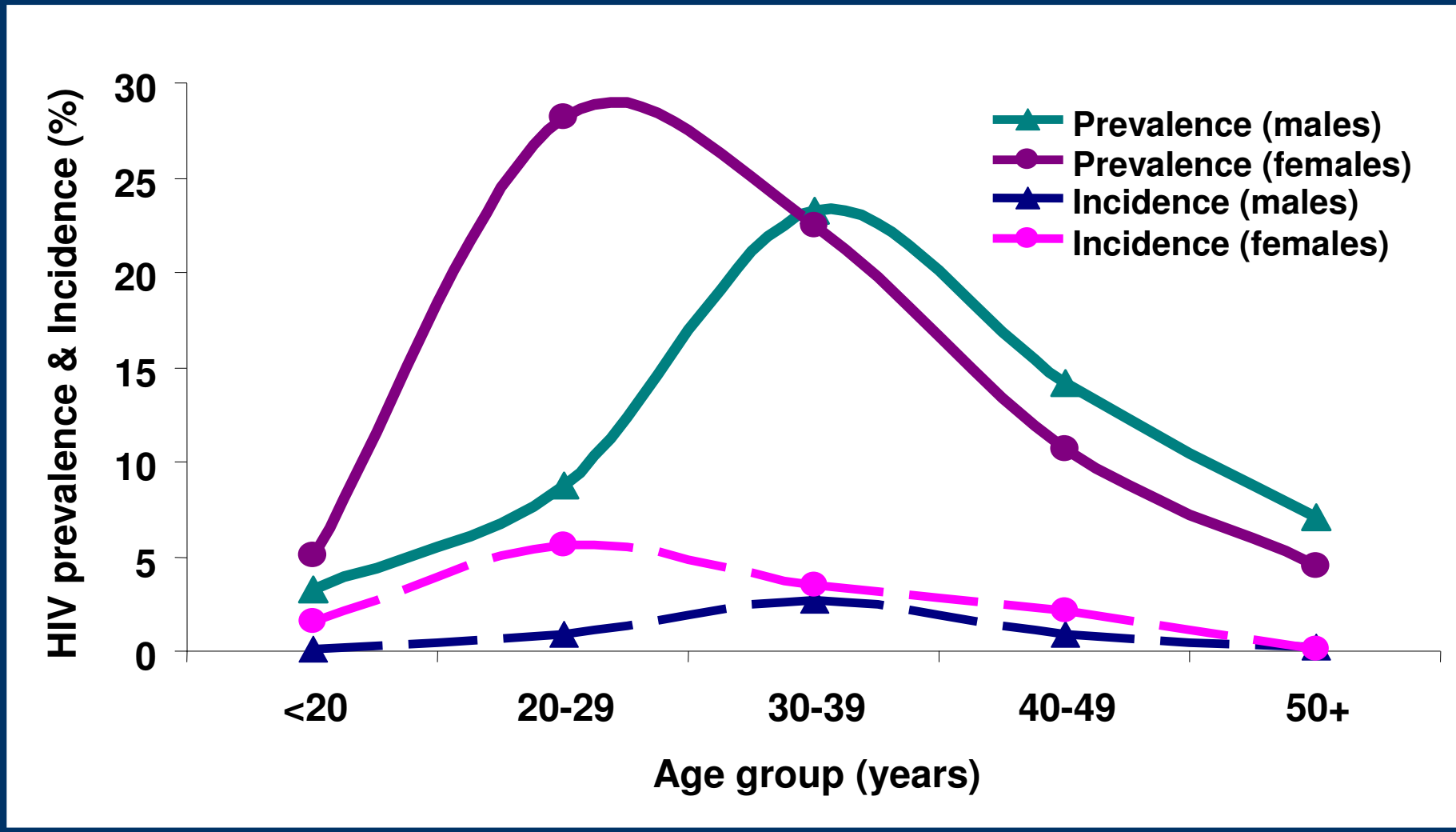
Window period = 180 days

Incidence = number of new infections per year per 100 persons at risk (% / year)

HIV incidence % and number of new infections by age group, South Africa 2005

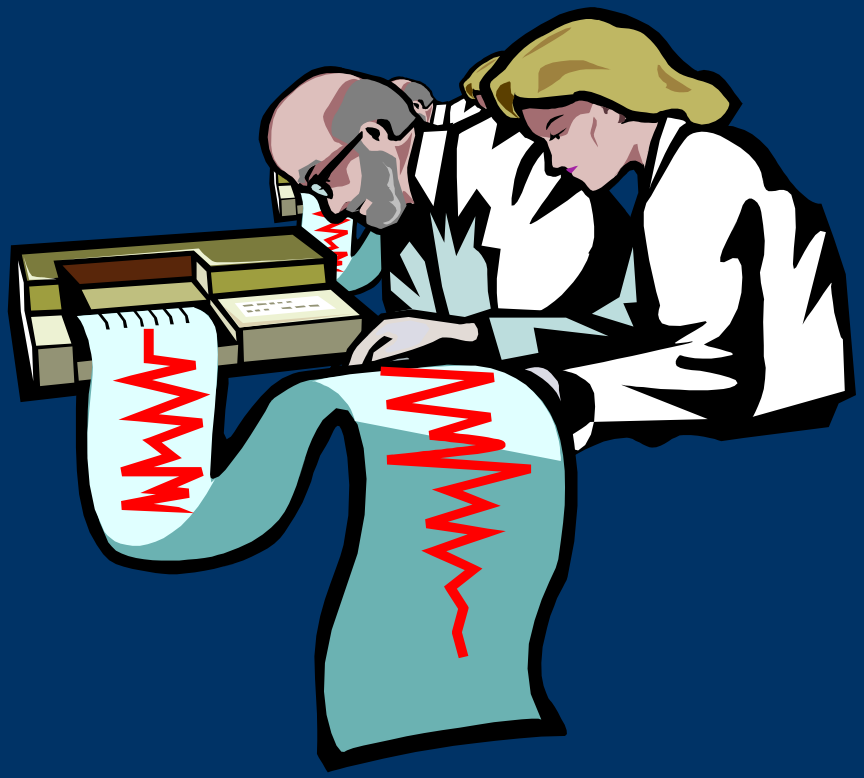
Age group (years)	Weighted sample (n)	HIV incidence % per year [95%CI]	Estimated number of new infections per year (n)
≥ 2	44 513 000	1.4 [1.0 - 1.8]	571 000
2-14	13 253 000	0.5 [0.0 - 1.2]	69 000
15-24	9 616 000	2.2 [1.3 - 3.1]	192 000
15-49	24 572 000	2.4 [1.7 – 3.2]	500 000

HIV prevalence and HIV incidence by age and sex, South Africa 2005

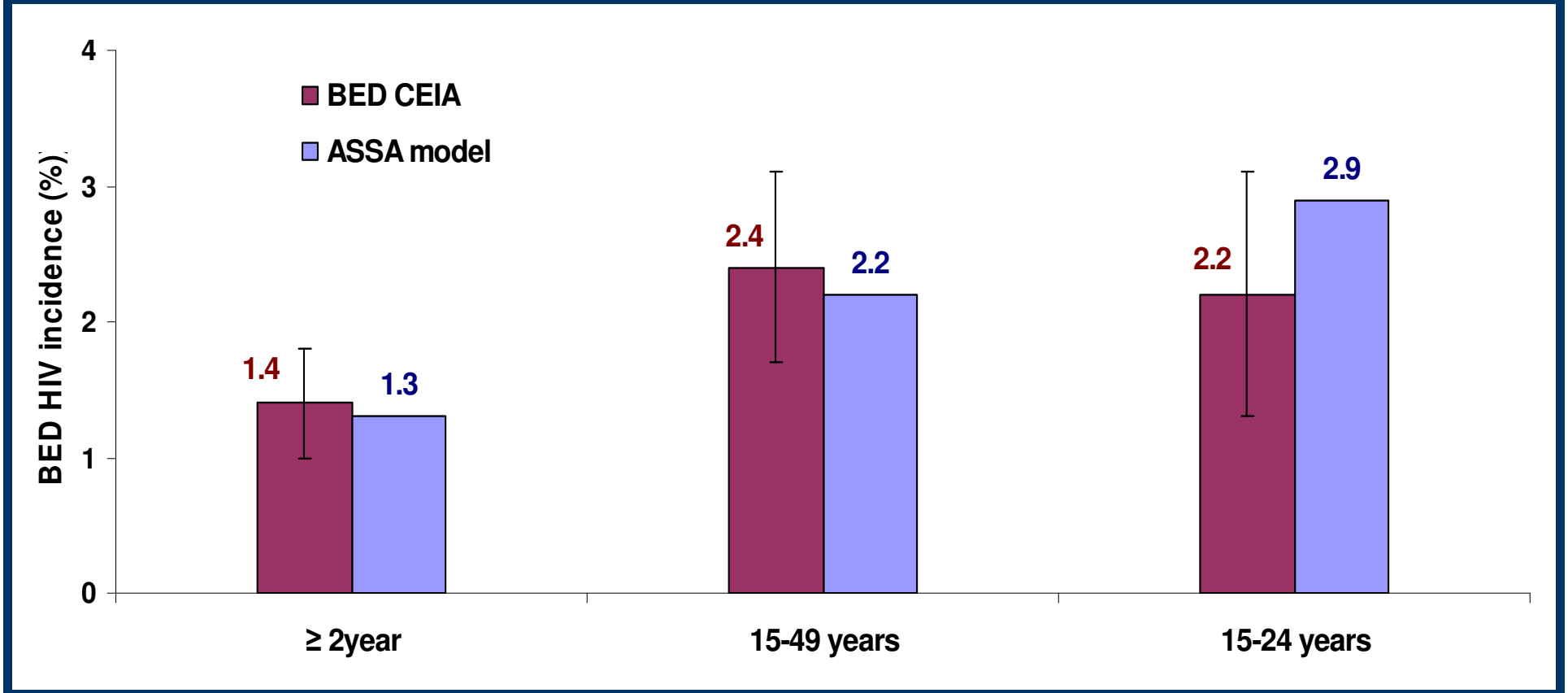


Rehle *et al*. SAMJ 2007; 97: 194-199

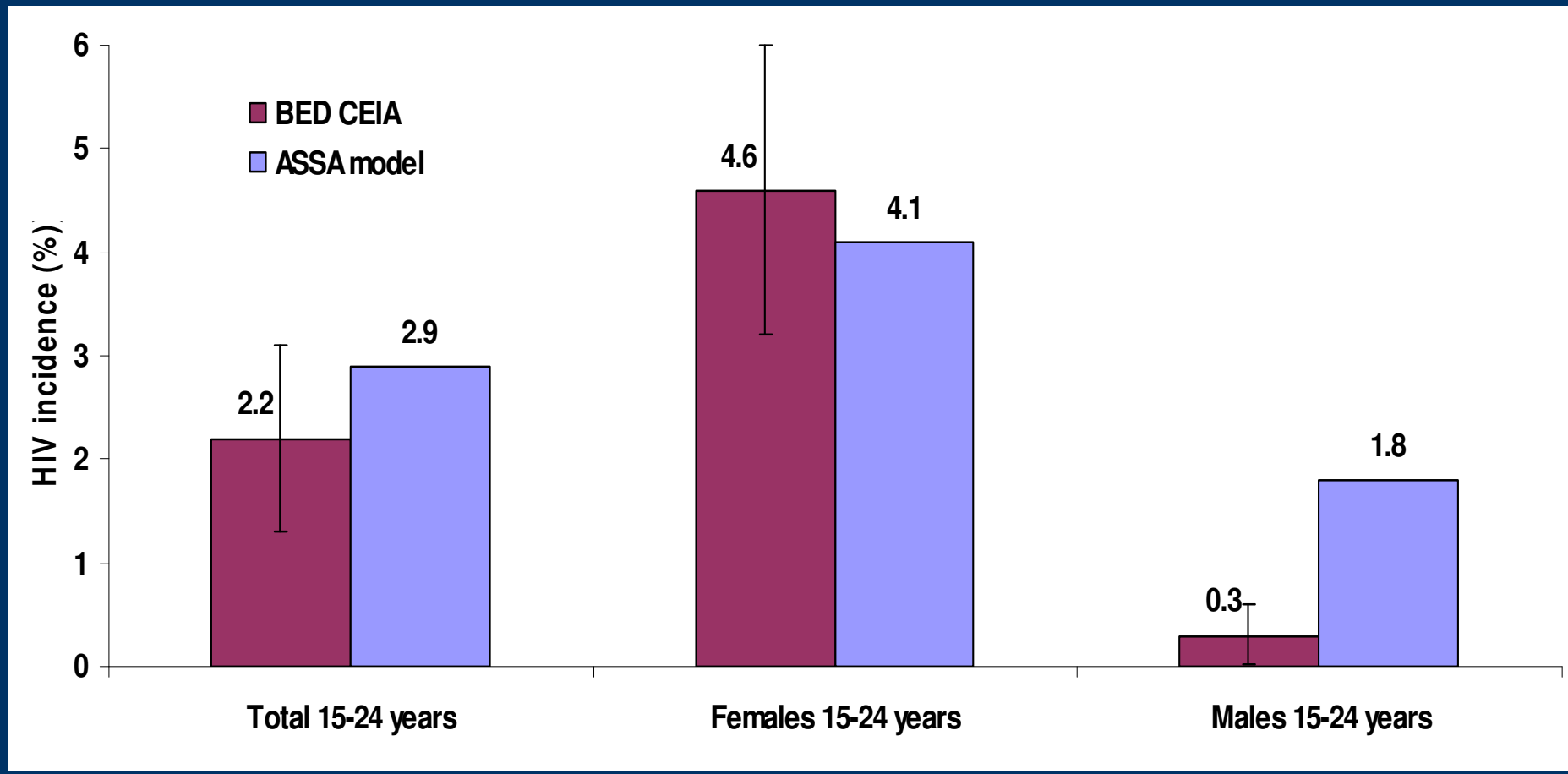
Are the adjusted BED HIV incidence estimates plausible?



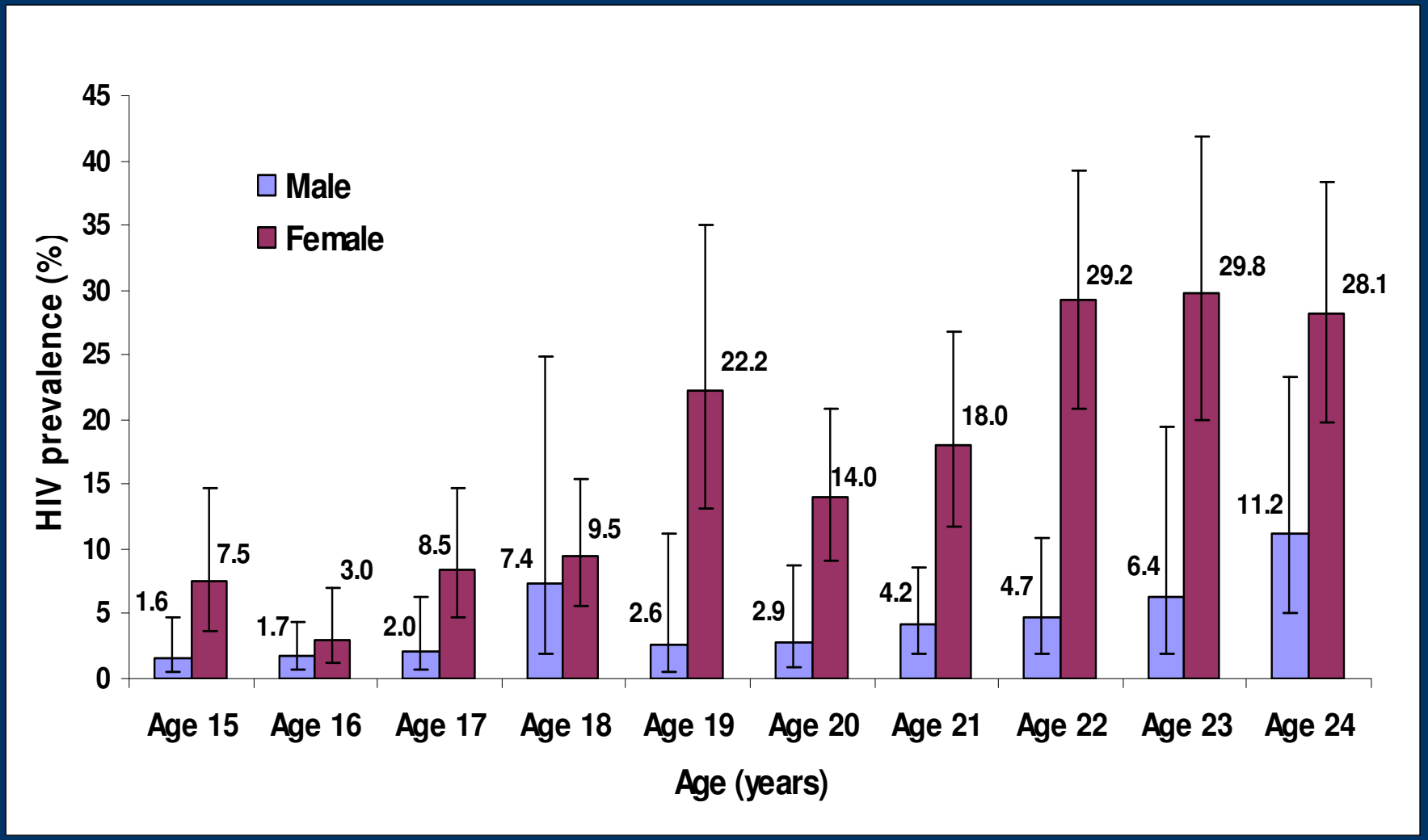
BED HIV incidence vs ASSA model (estimates for 2005)



BED HIV incidence vs ASSA model: male and female youth 15-24 years



HIV prevalence in youth by single year of age HSRC 2005



HIV incidence and behaviour
HSRC 2005 (age group 15 – 49 years)

Variable	HIV incidence (% per year)
Marital status	
Single	3.0
Married	1.3
Widowed	5.8
Sexual history	
Sexually active in the past 12 months	2.4
Current pregnancy	5.2
Condom use at last sex (15-24 yrs)	
Yes	2.9
No	6.1

(Rehle et al. S Afr Med J 2007; 97: 194-199)

Conclusion

- Incidence measures are generally better than prevalence measures for assessing current HIV-transmission dynamics and the impact of HIV prevention programs
- Laboratory-based HIV incidence estimation from representative cross-sectional surveys is method of choice for national HIV incidence surveillance
- Assay-based HIV incidence analysis needs to account for ART-related misclassification