Estimating HIV prevalence in European countries

Ard van Sighem, PhD
Stichting HIV Monitoring on behalf of the HIV modelling project team
Copenhagen, 19 March 2012
HIV in 2010

34 million living with HIV
2.7 million new infections

Source: UNAIDS
HIV in Europe

- Ca. 1 million people living with HIV/AIDS in Europe.

- Infection with HIV does not always produce symptoms that lead to diagnosis around the time of infection.

- Many people with HIV are not aware of their infection.

- Accurate estimates of the number of people with HIV for all countries in the region are necessary for a full response to the HIV epidemic.
Estimating number of HIV infections

Three approaches:

- based on prevalence surveys
- based on reconstructing HIV incidence curves
- based on relationship between CD4 count and AIDS
Estimating number of HIV infections

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Prevalence and risk group size

HIV prevalence $\times$ MSM size = number with HIV
Limitations and issues

- Matching prevalence and risk group size:
  - same population.
  - same time period.

- Difficult to measure prevalence and risk group size.

- What risk groups to divide the population into?

- No or sparse information for certain risk groups.
Estimating number of HIV infections

Three approaches:

• based on prevalence surveys

• based on reconstructing HIV incidence curves

• based on relationship between CD4 count and AIDS
Original back-calculation: AIDS \rightarrow HIV
Original back-calculation: AIDS → HIV

HIV infections

Observed AIDS cases

Calendar year
Original back-calculation: AIDS → HIV

HIV population: number of infections – number of deaths
Curve linking infection and diagnosis

Complications:
- curve is unknown
- curve may change over time

HIV diagnoses

![Graph showing HIV diagnoses over years from infection]

- Infected 1995
- Infected 2005

Years from infection
New infections and diagnosis rate

New diagnoses

Number of people

Diagnosis rate

2003 2004 2005 2006 2007 2008
New infections and diagnosis rate

- **New infections:**
  - 2003: 0
  - 2004: 1000
  - 2005: 2000
  - 2006: 3000
  - 2007: 4000
  - 2008: 5000

- **Diagnosis rate:**
  - 2003: 0.2
  - 2004: 0.3
  - 2005: 0.4
  - 2006: 0.5
  - 2007: 0.6
  - 2008: 0.7

- **New diagnoses:**
  - 2003: 0
  - 2004: 1000
  - 2005: 2000
  - 2006: 3000
  - 2007: 4000
  - 2008: 5000
New infections and diagnosis rate

- New infections: Number of people
- Diagnosis rate: Diagnosis rate

Graph showing the increase in new infections and diagnosis rate from 2003 to 2008.
New infections and diagnosis rate

Use CD4 counts or simultaneous HIV/AIDS diagnoses to distinguish between these two scenarios.
Existing methods

Bayesian back-calculation using a multi-state model with application to HIV

Michael J. Sweeting1,*,†, Daniela De Angelis1,2,‡ and Odd O. Aalen

STATISTICS IN MEDICINE

Estimation of HIV Incidence in the United States

H. Irene Hall, PhD
Ruiguang Song, PhD
Philip Rhodes, PhD
Joseph Prejean, PhD
Oian Au, MS

Context Incidence of human immunodeficiency virus (HIV) in the United States has not been directly measured. New assays that differentiate recent vs long infections allow improved estimation of HIV incidence.

Objective To estimate HIV incidence in the United States.

Design, Setting, and Patients Remnant diagnostic serum specimen

JAMA. 2008;300(5):520-529

A multistate approach for estimating the incidence of human immunodeficiency virus by using HIV and AIDS French surveillance data

Cécile Sommen1,2,*,†, Ahmadou Alioum1,2 and Daniel Commenges1,2

1INSERM U897, Epidemiology and Biostatistics Research Center, Bordeaux, F-33076, France
2University of Bordeaux 2, Bordeaux, F-33076, France

STATISTICS IN MEDICINE

Increasing HIV transmission through male homosexual and heterosexual contact in Australia: results from an extended back-projection approach

H Wand,1 P Yan,2 D Wilton,1 A McDonald,1 M Middleton,1 J Kaldor1 and M Law1

1National Centre in HIV Epidemiology and Clinical Research, Sydney, Australia and 2Center for Infectious Disease Prevention and Control Population and Public Health Branch, Ottawa, Canada

HIV Medicine (2010)
## Data needed

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Underlying model

$I(t)$ → $\geq 500$ → $350-499$ → $200-349$ → $<200$ → AIDS

d_1(t) → q_1 → d_2(t) → q_2 → d_3(t) → q_3 → d_4(t) → q_4 → d_5(t)

Diagnosis
Underlying model

$I(t)$ → ≥500 → 350-499 → 200-349 → <200 → AIDS

$d_1(t)$ → $q_1$ → $d_2(t)$ → $q_2$ → $d_3(t)$ → $q_3$ → $d_4(t)$ → $q_4$ → $d_5(t)$

Diagnosis
Pilot countries
Results – MSM Germany and Denmark

Germany

Denmark
Estimating number of HIV infections

Three approaches:

• based on prevalence surveys

• based on reconstructing HIV incidence curves

• based on relationship between CD4 count and AIDS
**Relationship CD4 count and AIDS**

- **200 people undiagnosed with CD4 count < 200**
  - **50 people expected to develop AIDS over a one year period**
  - **AIDS rate in people with CD4 count < 200 is ~0.25 per year**

- **200 people undiagnosed with CD4 count <200**
  - **50 simultaneous HIV/AIDS diagnoses in people with CD4 count <200**

Lodwick *et al.*
EACS 2009

Can be done on one year’s data collection!
Complications - data

- Underreporting.
- Double counting.
- Delayed reporting to national surveillance system.
- Incomplete information.
- Implicit assumption: everyone will be diagnosed eventually.
- Mortality in HIV-infected individuals.
- More data appear to be available outside TESSy.
Complications - methods

- Choosing parameters
  - infection curve
  - time intervals

- CD4 – AIDS model underestimates undiagnosed population:
  - people sometimes test due to pre-AIDS symptoms.
  - need to include also cases of HIV-related symptoms at diagnosis.

- Need estimates of uncertainty.
Summary and conclusions

- Three methods to estimate HIV prevalence.
- Reconstruction of the infection curve looks promising.
- CD4 – AIDS method needs further testing on country data.
- Understanding of the data is crucial!
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