

Estimating the Rate of HIV Transmission from Homosexual Men on Treatment to their HIV-uninfected partners.

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BACKGROUND:

Rate of HIV transmission is related to plasma viral load.

It is assumed that there is effectively no risk of transmission when viral load is undetectable.

This rate of transmission is not known and unlikely to be zero.

Aim of the current model:

To estimate the rate of HIV transmission from men who have sex with men (MSM) in the Netherlands.

And to determine how is this influenced by:

Patterns of condom use?

Schedules of viral load monitoring?

METHODS:

Stochastic mathematical model: individual-based simulation of viral load during first line treatment, HIV transmission and patient monitoring

The model was parameterized using data from the ATHENA cohort.

3 distinct viral load trajectories were considered in the model (figure 1)

Risk of transmission: the probability that an individual on treatment

will infect his uninfected sexual steady partner during first-line-treatment.

Functional relationship between plasma viral load and transmission in each sex act based on Hill distribution (Fraser, 2007)

Rescaled to match the risk per sex act for MSM (Wilson, 2008)

Assumed 100 sex acts per year with a steady partner

Scenarios for condom use:

- Never using condoms
- Using condoms in 30% of sex acts
- No condom use if viral load measurement in last 6 months was undetectable (and 3 months)
- Always using condoms

RESULTS mathematical model

Risk of HIV transmission is 22% if men do not use condoms (figure 2)

If condoms are used in 30% of the sex acts, this risk is reduced to 17%.

The chance of transmission is 3% if men use condoms, unless their viral load in the last 6 months was undetectable (figure 2).

In case patients are basing their decision to use condoms on their last viral load:

- then frequent monitoring provides up to date information on transmission risk and so minimizes the number of occasions when viral load has increased and condoms are not used.
- if patients are monitored every 18 months, transmission risk is 18%, this risk is much lower if monitoring is every 3 months, also this risk is lower compared to basing the decision to use condoms on a measurement 6 months ago. (figure 3).

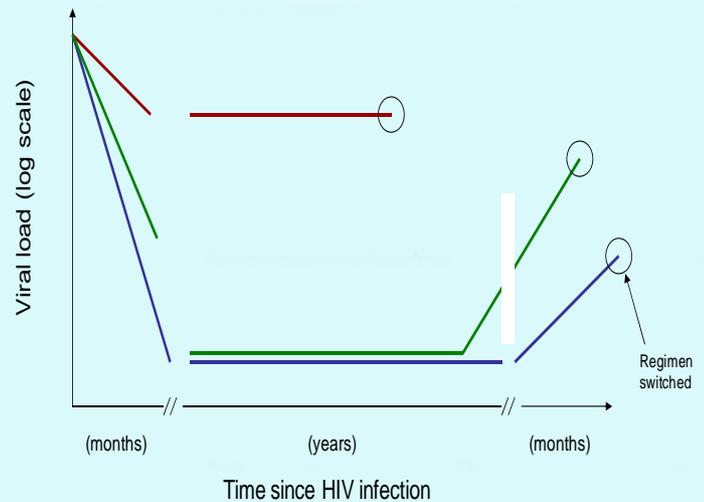


Figure 1: Schematic representation of the three assumed trajectories of (log) viral load following treatment initiation: suppression achieved and adherence good (blue line); suppression achieved but adherence poor (green line); and suppression not achieved (red line).

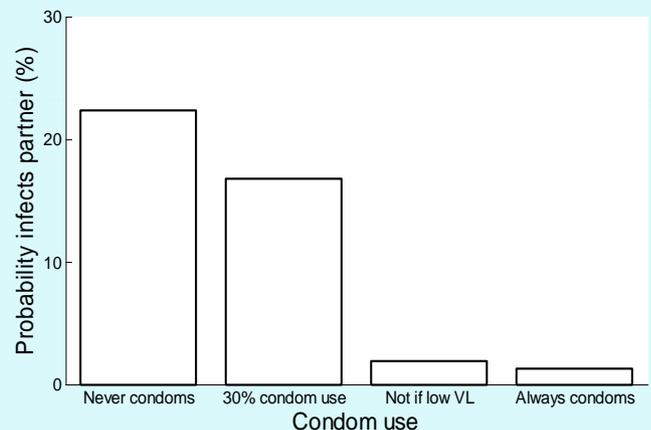


Figure 2: Probability of infection during first-line therapy, if (i) condoms are never used; (ii) condoms are used 30% of the time; (iii) condoms are used unless last viral load measurement in last 6 months was undetectable versus (iv) always using condoms

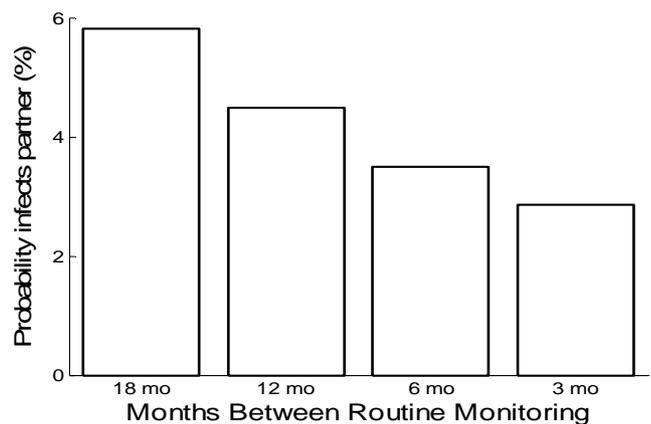


Figure 3: The influence of (a) monitoring frequency and (b) loss to follow-up on the probability of HIV transmission, assuming condoms are used unless last viral load measurement in last 6 months was undetectable.

CONCLUSIONS

A small rate of transmission will translate into a large number of new infections.

Condom use is the best way to protect a partner

For patients who prefer not to use condoms during all sex acts with a steady partner, stress the need for condom use when the last viral load is more than 3 months ago.