Estimating the rate of HIV transmission from men on treatment

Colette Smit[1], Tim Hallett[2], Geoff Garnett[2], Frank de Wolf[1,2]

[1] HIV Monitoring Foundation, Amsterdam
[2] Imperial College, London

STICHTING HIV MONITORING

Background

Rate of HIV transmission from infected persons to their uninfected partners is related to plasma viral load.

HIV treatment can reduce plasma viral load to undetectable levels.

According to The Swiss Federal Commission for HIV/AIDS: effectively no risk of sexual transmission from patients on treatment with undetectable viral loads in the last six months (The Swiss Statement)

However, this rate of transmission is not known and unlikely to be zero.

Aim of current mathematical model:

What is the rate of HIV transmission from men who have sex with men (MSM) in the Netherlands?

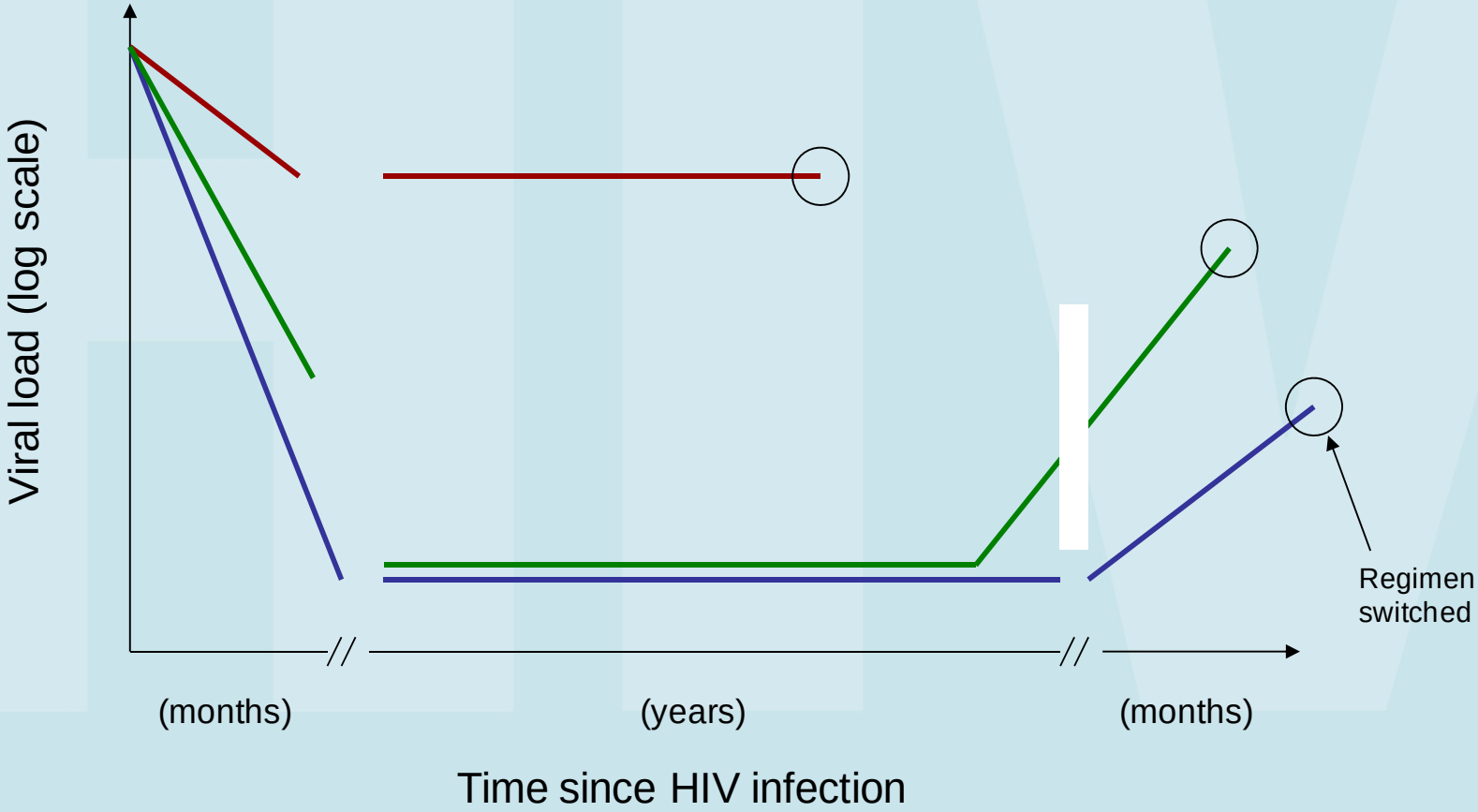
How is this influenced by:

- Patterns of condom use?
- Schedules of viral load monitoring?

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

(Hallett, PLoS Med; Smit PLoS One)

Schematic representation of the three assumed trajectories of viral load



Suppression achieved and good adherence (blue line);
Suppression achieved but poor adherence (green line); and,
Suppression not achieved (red line). The circles indicate when the regimen is switched.

STICHTING HIV MONITORING

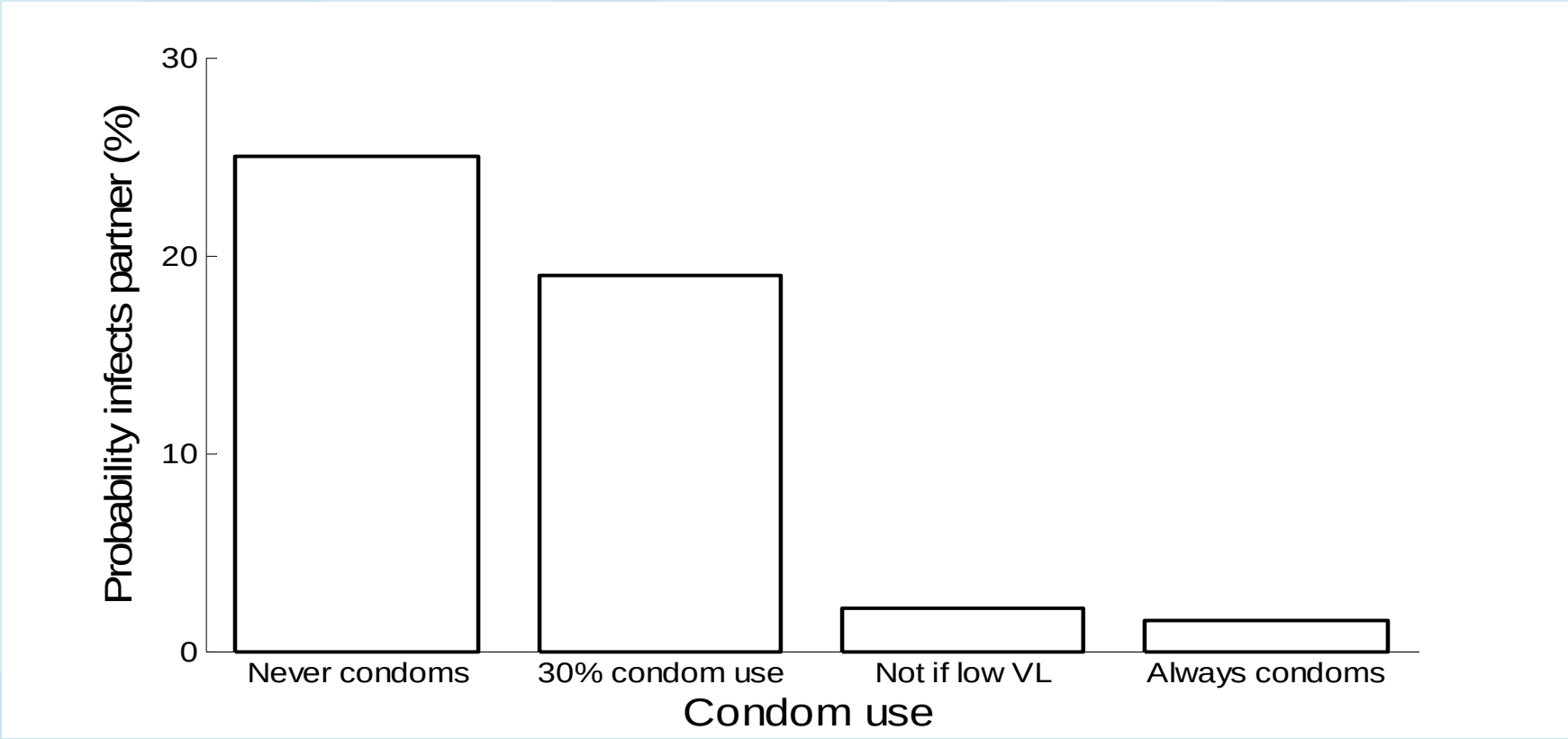
- Risk of transmission: the probability that an individual on treatment will infect his uninfected sexual partner during treatment.

- 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

- 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
  - Always using condoms

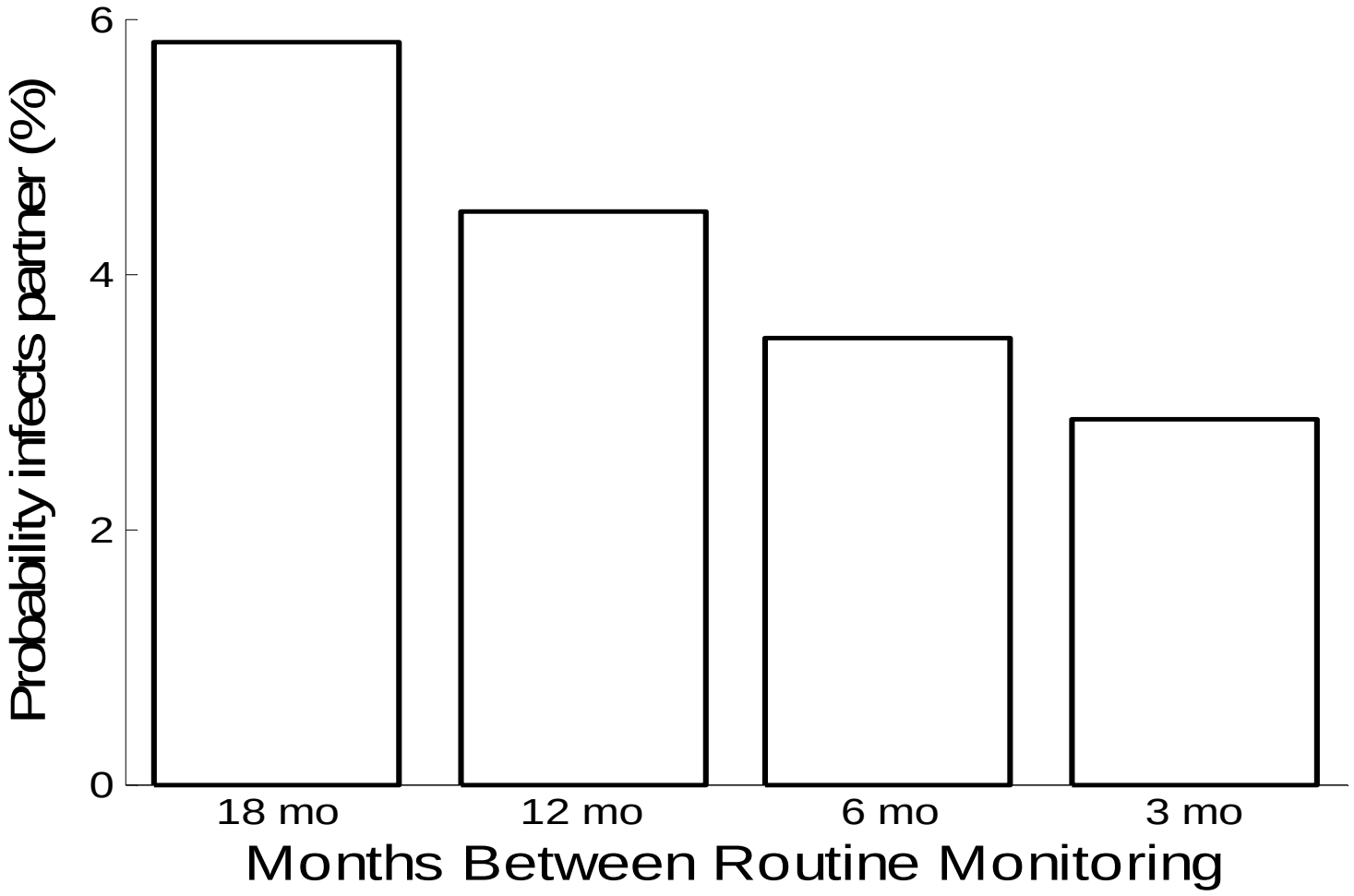
Probability of HIV transmission during first line therapy



(1) condoms are never used;
(2) condoms are used 30% of the time;
(3) condoms are used unless last viral load measurement in last 6 months was undetectable;
(4) condoms are always used.

STICHTING HIV MONITORING

Frequency of viral load measurements on the probability of HIV transmission



STICHTING HIV MONITORING

- Earlier modeling work and the Swiss statement did not consider the way in which deciding not to use condoms could be conditional on the last viral load measurement.
- There was also little focus on estimating the rate of HIV transmission or exploring how it is influenced by patterns of patient monitoring

Key message to patients:

- A small rate of transmission will translate into a large number of new infections.
- Condom use best way to protect partner
- Second best strategy is to stress condom use when last viral load is more than 3 months ago.

Acknowledgments

Imperial college London: Tim Hallett, Geoff Garnett, Frank de Wolf

The ATHENA database is supported by a grant from the Dutch Health Minister and was set up and is maintained by the Stichting HIV Monitoring. The physicians and data analysts include (*Site coordinating physicians): Prof. dr. F. de Wolf (director), Dr. D.O. Bezemer, Drs. L.A.J. Gras, Drs. A.M. Kesselring, Dr. A.I. van Sighem, Dr. C. Smit, Drs. S. Zhang (data analysis group), Drs. S. Zaheri (data collection), Stichting HIV Monitoring, Amsterdam; Dr. J.M. Prins*, Drs. J.C. Bos, Dr. J.K.M. Eeftinck-Schattenkerk, Dr. S.E. Geerlings, Dr. M.H. Godfried, Prof. dr. J.M.A. Lange, Dr. J.T.M. van der Meer, Dr. F.J.B. Nellen, Dr. T. van der Poll, Prof. dr. P. Reiss, Drs. S.U.C. Sankatsing, Drs. M. van der Valk, Drs. J.N. Vermeulen, Drs. S.M.E. Vrouenraets, Dr. M. van Vugt, Dr. F.W.M.N. Wit, Academisch Medisch Centrum bij de Universiteit van Amsterdam, Amsterdam; Dr. G. Schreij*, Dr. S. van der Geest, Dr. A. Oude Lashof, Dr. S. Lowe, Dr. A. Verbon, Academisch Ziekenhuis Maastricht; Maastricht; Dr. B. Bravenboer*, Drs. M.J.H. Pronk, Catharina Ziekenhuis, Eindhoven; Prof. dr. T.W. Kuijpers, Drs. D. Pajkrt, Dr. H.J. Scherpbier, Emma Kinderziekenhuis, AMC, Amsterdam; Dr. M.E. van der Ende*, Drs. H. Bax, Drs. M. van der Feltz, Dr. L.B.S. Gelinck, Dr. J.L. Nouwen, Dr. B.J.A. Rijnders, Dr. E.D. de Ruiter, Dr. L. Slobbe, Drs. C.A.M. Schurink, Dr. T.E.M.S. de Vries-Sluijs, Erasmus MC, Rotterdam; Dr. G. Driessen, Dr. N.G. Hartwig, Erasmus MC – Sophia, Rotterdam; Dr. J. Branger, Drs. M.H. Hoogewerf, Flevoziekenhuis, Almere; Dr. R.H. Kauffmann*, Dr. E.F. Schippers, Haga Ziekenhuis, locatie Leyenburg, Den Haag; Dr. P.H.P. Groeneveld*, Dr. M.A. Alleman, Isala Klinieken, Zwolle; Prof. dr. R.W. ten Kate*, Dr. R. Soetekouw, Kennemer Gasthuis, Haarlem; Dr. F.P. Kroon*, Dr. S.M. Arend, Drs. M.G.J. de Boer, Prof. dr. P.J. van den Broek, Prof. dr. J.T. van Dissel, Drs. C. van Nieuwkoop, Leids Universitair Medisch Centrum, Leiden; Dr. J.G. den Hollander*, Maasstadziekenhuis, locatie Clara, Rotterdam; Dr. W. Bronsveld*, Dr. K. Pogany, Medisch Centrum Alkmaar, Alkmaar; Dr. R. Vriesendorp*, Dr. E.M.S. Leyten, Medisch Centrum Haaglanden, locatie Westeinde, Den Haag; Dr. D. van Houte*, Dr. M.B. Polée, Dr. M.G.A. van Vonderen, Medisch Centrum Leeuwarden, Leeuwarden; Dr. C.H.H. ten Napel*, Dr. G.J. Kootstra, Medisch Spectrum Twente, Enschede; Prof. dr. K. Brinkman*, Drs. G.E.L. van den Berk, Dr. W.L. Blok, Dr. P.H.J. Frissen, Drs. W.E.M. Schouten, Onze Lieve Vrouwe Gasthuis, Amsterdam; Dr. A. van Eeden*, Dr. D.W.M. Verhagen, St. Medisch Centrum Jan van Goyen, Amsterdam; Dr. J.W. Mulder*, Dr. E.C.M. van Gorp, Dr. J. Wagenaar, Slotervaart Ziekenhuis, Amsterdam; Dr. J.R. Juttmann*, Dr. M.E.E. van Kasteren, St. Elisabeth Ziekenhuis, Tilburg; Dr. J. Veenstra*, Dr. K.D. Lettinga. St. Lucas Andreas Ziekenhuis, Amsterdam; Dr. P.P. Koopmans*, Drs. A.M. Brouwer, Dr. A.S.M. Dofferhoff, Dr. M. van der Flier, Prof. dr. R. de Groot, Drs. H.J.M. ter Hofstede, Dr. M. Keuter, Dr. A.J.A.M. van der Ven, Universitair Medisch Centrum St. Radboud, Nijmegen; Dr. H.G. Sprenger*, Dr. S. van Assen, Dr. C.J. Stek, Universitair Medisch Centrum Groningen, Groningen; Dr. R. Doedens, Dr. E.H. Scholvinck, Universitair Medisch Centrum Groningen, Beatrix Kliniek, Groningen; Prof. dr. I.M. Hoepelman*, Prof. dr. M.J.M. Bonten, Dr. P.M. Ellerbroek, Drs. E. Hoornenborg, Drs. C.A.J.J. Jaspers, Drs. L.J. Maarschalk-Ellerbroek, Dr. T. Mudrikova, Dr. J.J. Oosterheert, Dr. E.J.G. Peters, Dr. M.M.E. Schneider, Drs. M.W.M. Wassenberg, Dr. S. Weijer, Universitair Medisch Centrum Utrecht, Utrecht; Dr. S.P.M. Geelen, Dr. T.F.W. Wolfs, Wilhelmina Kinderziekenhuis, UMC Utrecht, Utrecht; Prof. dr. S.A. Danner*, Dr. M.A. van Agtmael, Drs. W.F.W. Bierman, Drs. F.A.P. Claessen, Drs. M.E. Hillebrand, Drs. E.V. de Jong, Drs. W. Kortmann, Dr. R.M. Perenboom, Drs. E.A. bij de Vaate, VU Medisch Centrum, Amsterdam; Dr. C. Richter*, Drs. J. van der Berg, Dr. E.H. Gisolf, Ziekenhuis Rijnstate, Arnhem; Dr. A.A. Tanis*, Ziekenhuis Walcheren, Vlissingen; Dr. A.J. Duits, Dr. A. Durand, Dr. F. Muskiet, Dr. R. Voigt, Dr. K. Winkel, St. Elisabeth Hospitaal/Stichting Rode Kruis Bloedbank

STICHTING HIV MONITORING