HIV/AIDS cost-effectiveness:
clinical / in practice

Dr Rémy Demeester
CHU de Charleroi
5th BREACH Symposium
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Cost of HIV management

- ± 12 000 euros/year/patient x 30 years = 360 000 euros/patient:
  - ± 90% = price of the drugs
  - > 5% = laboratory analyses
  - < 5% = human resources
- Every new infection risks to be the origin of 4 other infections (reproduction number).

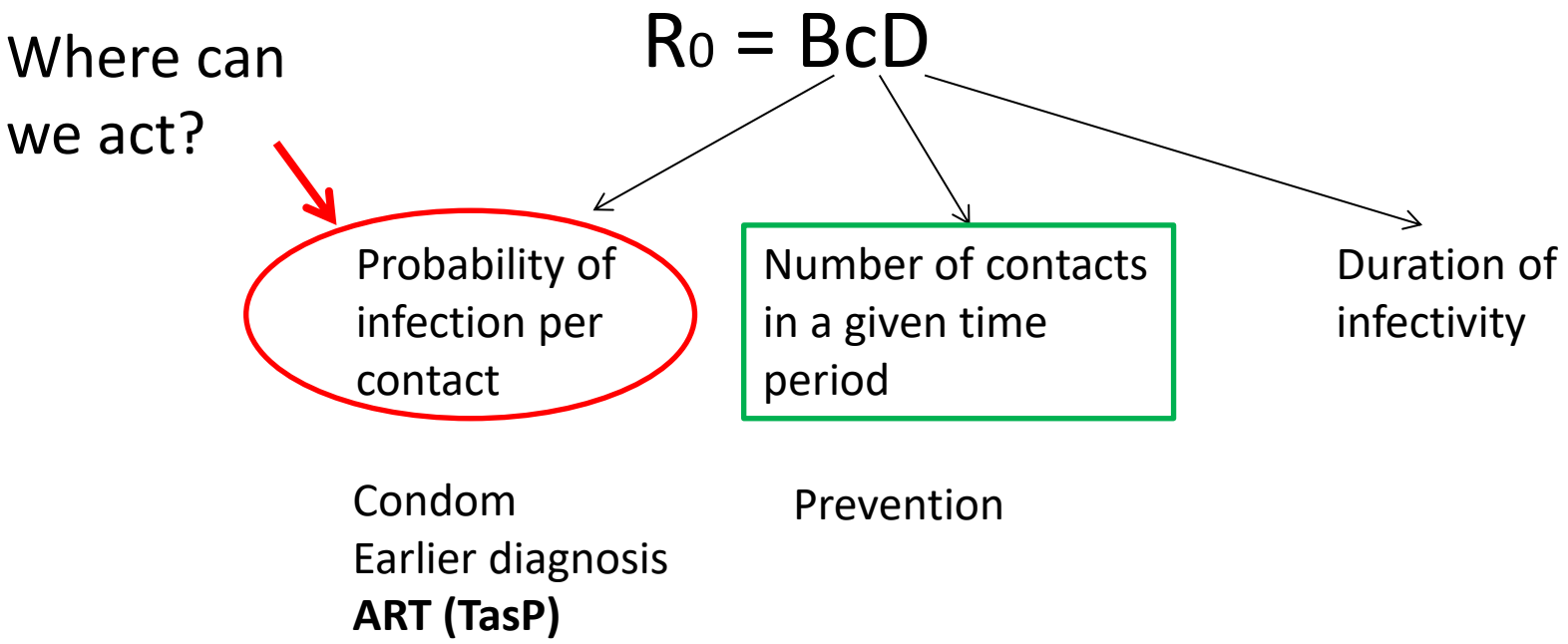
=> Every avoided infection represents consequent savings.

- Once someone is infected it will cost less to the society to treat him than not to treat him.

Nakagawa F et al. Projected Lifetime Healthcare Costs Associated with HIV Infection. PLoS ONE 10(4): e0125018

Reproduction number (R_0)

- Number of secondary infections that arise from a primary case:



Deblonde et al. Restricted access to antiretroviral treatment for undocumented migrants: a bottle neck to control the HIV epidemic in the EU/EEA. BMC Public Health (2015) 15: 1228.

Estimation of transmission rates

Transmission rates		
Sexual aware, not on ART annual transmission	0.0484	Prabhu et al[20]
Sexual aware, on ART annual transmission	0.0097	Prabhu et al[20] (calculated)
Sexual unaware annual transmission	0.1117	Prabhu et al[20] (calculated)
IDU aware annual transmission	0.126	Sanders et al[13], Zaric et al[21]
IDU unaware annual transmission	0.165	Sanders et al[13], Zaric et al[21]

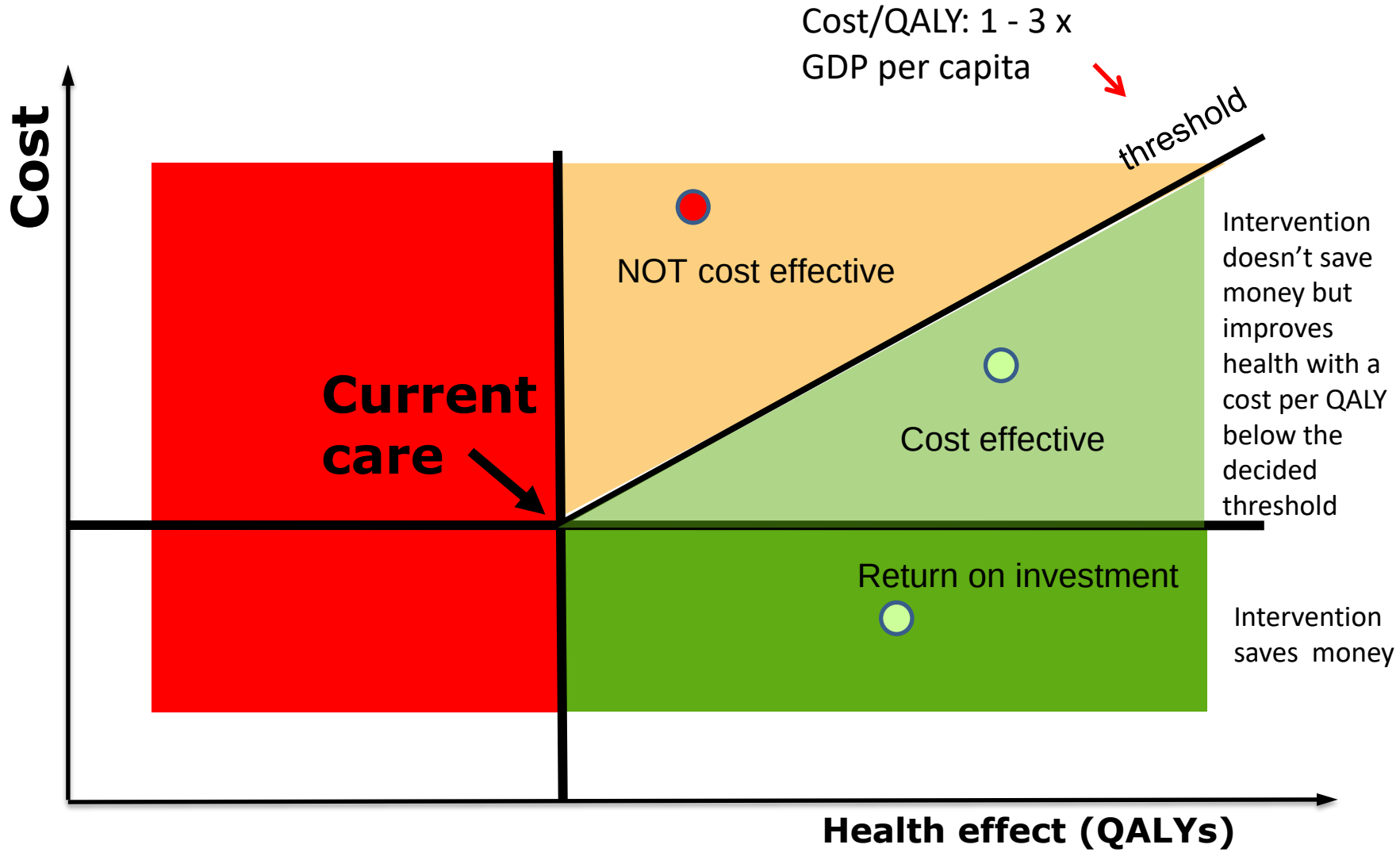
- **Awareness** of HIV serostatus reduces the transmission rate
- **Antiretroviral therapy** reduces the transmission rate

⇒ **Early diagnosis and treatment must be the goals:**

- Test, treat and retain strategy (90-90-90)
- Reduce the probability of infection per contact:
  - Condom
  - Syringe exchange
  - PrEP
  - …

Hutchinson A et al. Return on Public Health Investment: CDC's Expanded HIV Testing Initiative. JAIDS. Vol 59, n°3, March 1, 2012: 281-286.

Cost-effectiveness of interventions



Adapted from the presentation of Pr Lieven Annemans at Bridges symposium 2016: can our health care system afford medical innovations?

Cost-effectiveness: Prevention

Examples of the needle syringe exchange programs

Estimating the cost-effectiveness of needle-syringe programs in Australia

- Results:
  - Needle-syringe programs (NSP) reduced incidence of HIV by 34-70% (192-873 cases) and HCV by 15-43% (19 000- 77 000 cases) during 2000-2010:
  - 20 000-66 000 QALYs gained
  - 70-220 million $ in healthcare costs saved and additional 340-950 million $ in future healthcare costs.
  - 416-8750 $ per QALY gained.
  - **Future return on investment of 1,3-5,5$ for every 1$ invested.**

- Conclusions: NSPs are a cost effective public health strategy and result in substantial net cost savings.

Kwon J et al. Estimating the cost-effectiveness of needle-syringe programs in Australia. AIDS 2012, 26: 2201-2210.

Syringe Exchange in the United States: A National Level Economic Evaluation of Hypothetical Increases in Investment

- Modelization of HIV incidence in hypothetical cases with higher syringe supply than current levels.
- **Results:**
  - With an annual 10 to 50 million $ funding increase, **194-816 HIV infections would be averted**
    => cost per infection averted: 51601-61302 $.
  - Contrasted with HIV treatment cost savings alone, the rate of financial **return on investment would be 7,58-6,38**.

Trang Quynh Nguyen et al. Syringe Exchange in the United States: a National Level Economic Evaluation of Hypothetical Increases in Investment. AIDS Behav. 2014 November; 18(11): 2144-2155.

HIV-1 Outbreak among Drug Injectors in Athens

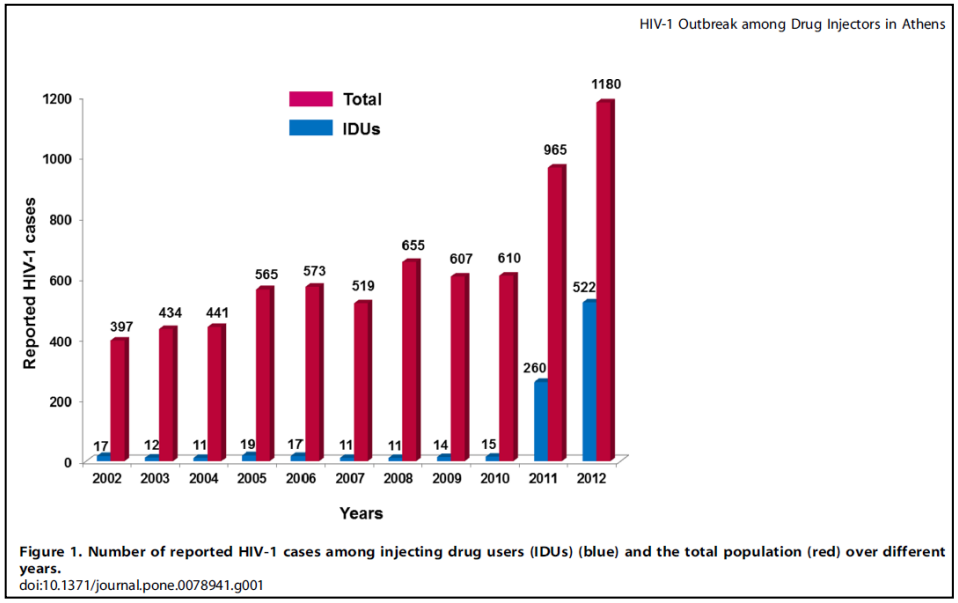


Figure 1. Number of reported HIV-1 cases among injecting drug users (IDUs) (blue) and the total population (red) over different years.
doi:10.1371/journal.pone.0078941.g001

- Number of diagnosis of HIV infection in IVDU in Greece: **311** in 2011, **518 in 2012**, **260** in 2013, **102** in 2014 reported by eCDC.

Paraskevis D et al. Economic Recession and Emergence of an HIV-1 Outbreak among Drug Injectors in Athens Metropolitan Area: a Longitudinal Study. PLOS One: november 2013, vol 8, issue 11: e78941.
eCDC: HIV/AIDS surveillance report 2014: www.ecdc.europa.eu

HIV-1 Outbreak among Drug Injectors in Athens

- **Outbreak linked to austerity** measures, cuts in public spending, **housing instability** and **unemployment** resulting from the political and financial crisis.
- « **Seek, test, treat and retain** » programme was launched to respond to this outbreak (ARISTOTLE programme).

Tsang M et al. Network charcteristics of people who inject drugs within a new HIV epidemic following austerity in Athens, Greece. JAIDS 2015 Aug 1; 69(4): 499-508.
Hatzakis A et al. Design and baseline findings of a large scale rapid response to an HIV outbreak in people who inject drugs in Athens, Greece: the ARISTOTLE programme. Addiction 2015 september; 110(9): 1453-67.

Cost-effectiveness: earlier diagnosis

Return on Public Health Investment: CDC's Expanded HIV Testing Initiative

Angela B. Hutchinson, PhD, MPH, Paul G. Farnham, PhD, Nadezhda Duffy, MD, MPH, Richard J. Wolitski, PhD, Stephanie L. Sansom, PhD, MPP, MPH, Samuel W. Dooley, MD, Janet C. Cleveland, PhD, and Jonathan H. Mermin, MD, MPH

- 102,3 million $ invested in a large scale HIV testing program over 3 years.
- Results:
  - 2,7 million person tested: positivity rate 0,7%
  - **If on average those persons would have been diagnosed 3 years later: 3381 HIV infections were averted.**
  - **Return of 1,95$ for every dollar invested.**
- Conclusions: provides support for large scale HIV testing programs.

Hutchinson A et al. Return on Public Health Investment: CDC's Expanded HIV Testing Initiative. JAIDS. Vol 59, n°3, March 1, 2012: 281-286.

Cost-effectiveness: treatment

Example of the population viral load approach

Expanding ART for Treatment and Prevention of HIV in South Africa: Estimated Cost and Cost-Effectiveness 2011-2050

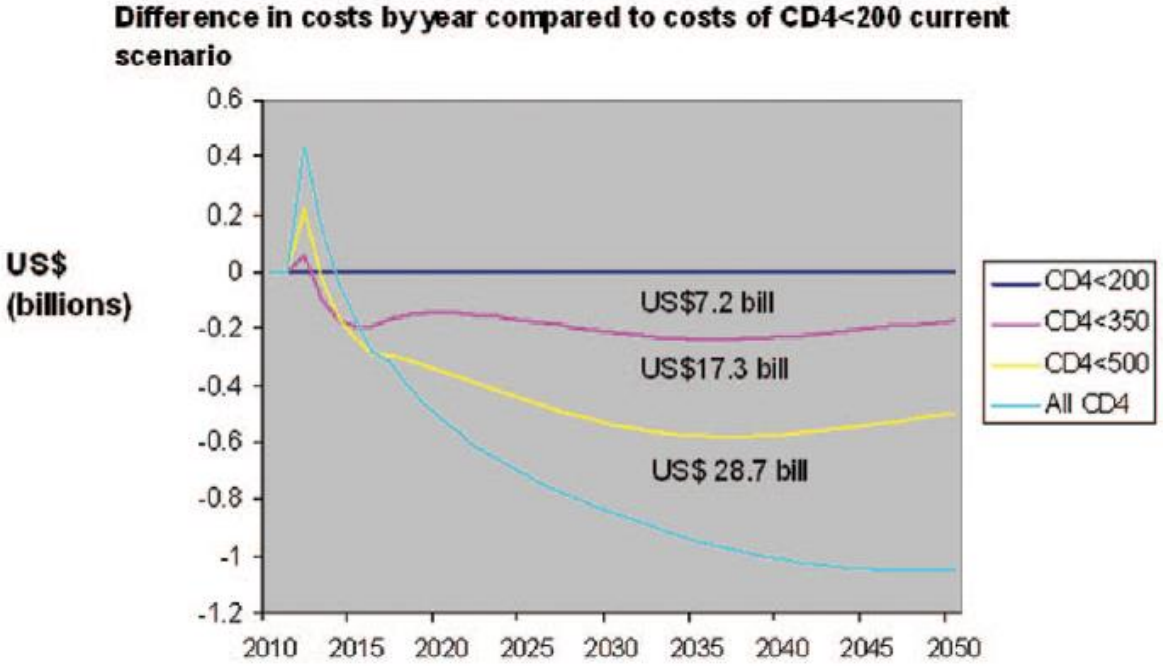


Figure 3. Annual cost by scenario compared to current prevention scenario baseline, 2010–2050. This figure shows the annual cost by ART scenario compared to the projected baseline of <200 current scenario. Totals represent cumulative cost savings over 2010–2050 time period. Cost neutral time points cluster around 2015. Discounted savings over 40 years are 3.9, 8.8, and 13.8 billion for <350, <500, and all CD4 cells, respectively.

Granich R et al. Expanding ART for treatment and prevention of HIV in South Africa: estimated cost and cost-effectiveness 2011-2050. PLOS One 7 (2): e30216.

Cost-effectiveness of population-level expansion of highly active antiretroviral treatment for HIV in British Columbia, Canada: a modelling study

Bohdan Nosyk, Jeong E Min, Viviane D Lima, Robert S Hogg, Julio S G Montaner, for the STOP HIV/AIDS study group*

Association of highly active antiretroviral therapy coverage, population viral load, and yearly new HIV diagnoses in British Columbia, Canada: a population-based study

Julio S G Montaner, Viviane D Lima, Rolando Barrios, Benita Yip, Evan Wood, Thomas Kerr, Kate Shannon, P Richard Harrigan, Robert S Hogg, Patricia Daly, Perry Kendall

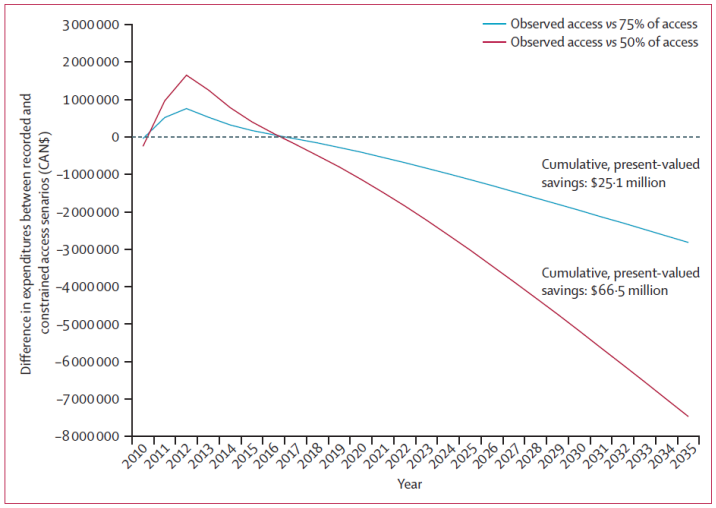


Figure 2: **Projected differences in expenditures between observed access to ART scale-up and hypothetical constrained-access scenarios**
Data for observed access to ART scale-up were from 1997 to 2010. Plotted differences in yearly expenditures were not discounted. Costs presented in 2010 $CAN, discounted at an yearly rate of 3%. Difference in total expenditure, 1997–2035, for the observed access to ART scale-up scenario compared with the 75% and 50% probability access scenarios. ART=antiretroviral treatment.

« There is a strong population-level association between increasing HAART coverage, decreased viral load, and decreased number of new HIV diagnoses per year ».

Nosyk B et al. Cost-effectiveness of population-level expansion of highly active antiretroviral treatment for HIV in British Columbia, Canada: a modelling study. Lancet HIV 2015; 2: 393-400.
Montaner J et al. Association of highly active antiretroviral therapy coverage, population viral load, and yearly new HIV diagnoses in British Columbia, Canada: a population-based study. Lancet 2010; 376: 532-39.

Cost-effectiveness: the continuum of care

Comparison of continuum of care: Belgium - USA

10 to 20% of undiagnosed PLWHIV

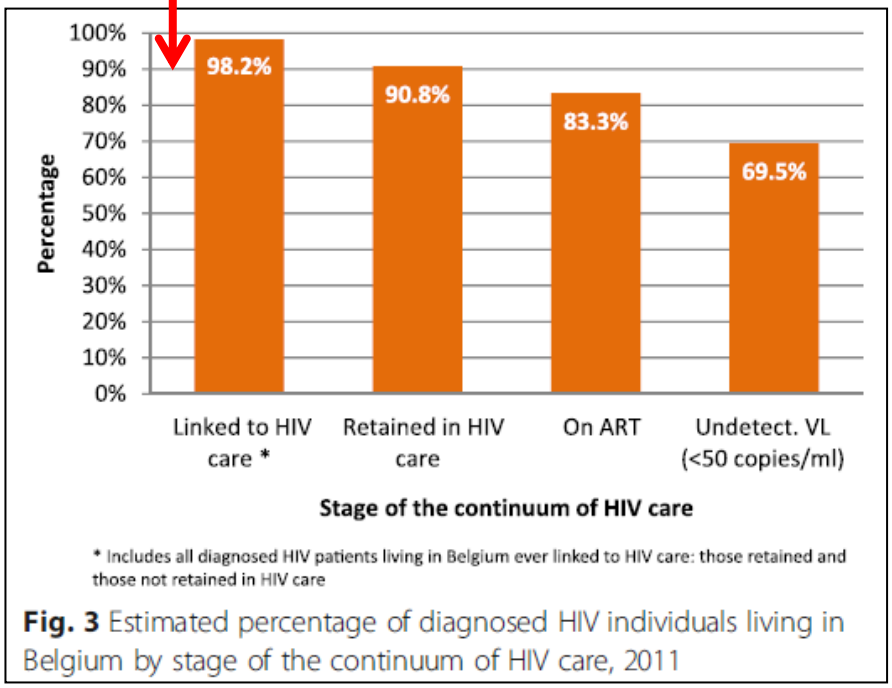


Fig. 3 Estimated percentage of diagnosed HIV individuals living in Belgium by stage of the continuum of HIV care, 2011

Belgium

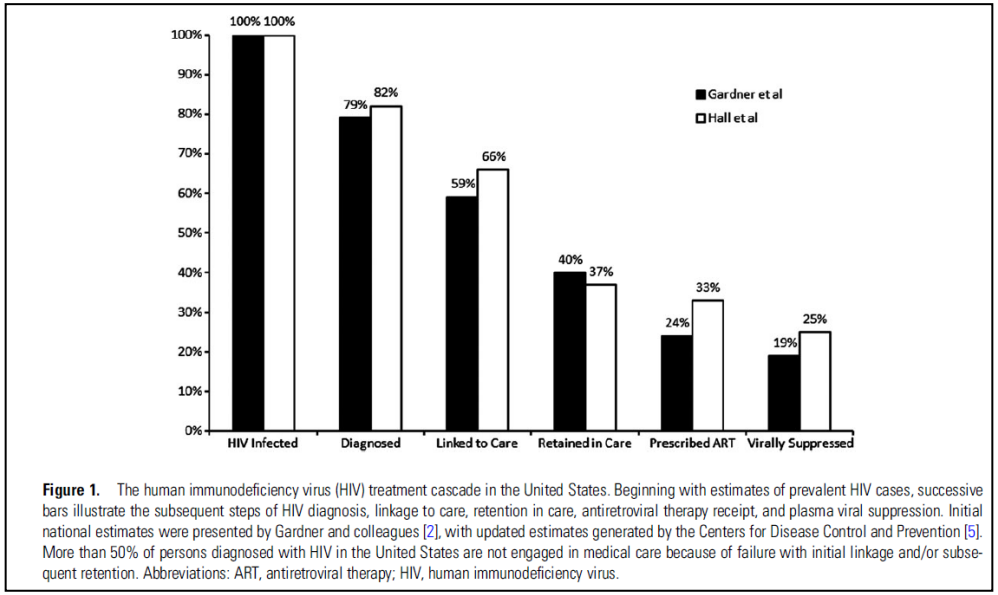


Figure 1. The human immunodeficiency virus (HIV) treatment cascade in the United States. Beginning with estimates of prevalent HIV cases, successive bars illustrate the subsequent steps of HIV diagnosis, linkage to care, retention in care, antiretroviral therapy receipt, and plasma viral suppression. Initial national estimates were presented by Gardner and colleagues [2], with updated estimates generated by the Centers for Disease Control and Prevention [5]. More than 50% of persons diagnosed with HIV in the United States are not engaged in medical care because of failure with initial linkage and/or subsequent retention. Abbreviations: ART, antiretroviral therapy; HIV, human immunodeficiency virus.

USA

Van Beckhoven D et al. Good continuum of HIV care in Belgium despite weaknesses in retention and linkage to care among migrants. BMC Infectious Diseases (2015) 15:496
Mugavero M et al. The state of engagement in HIV Care in the United States: from Cascade to Continuum to Control. CID 2013: 57 (8): 1164-71

Comparison of continuum of care: Belgium - USA

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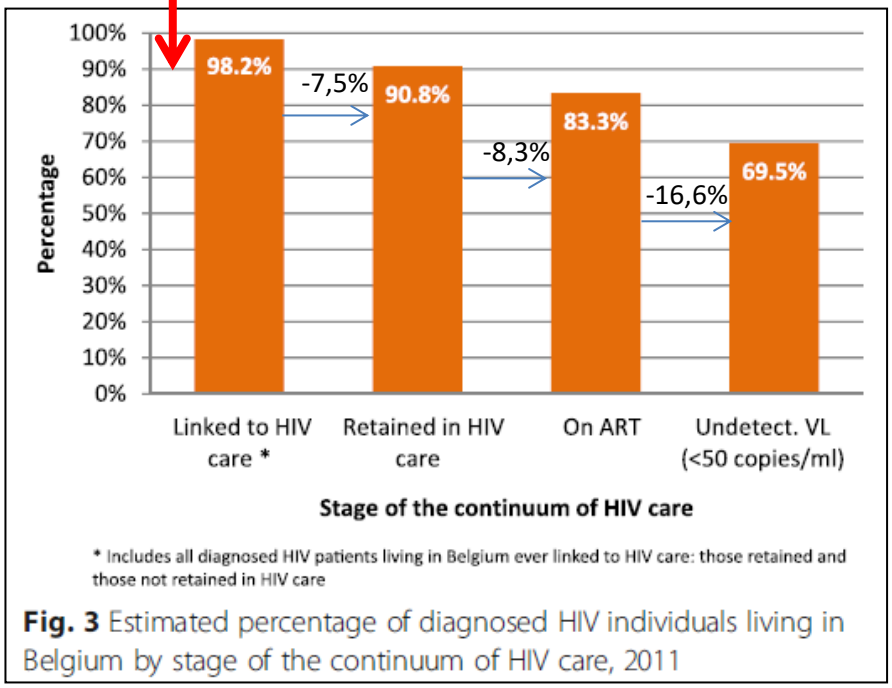

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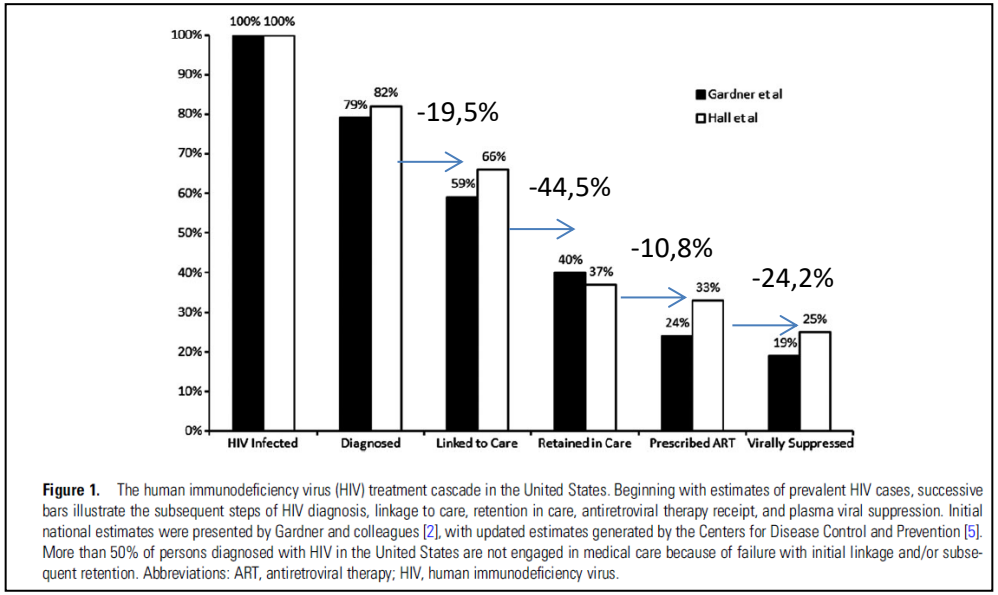

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Continuum of care

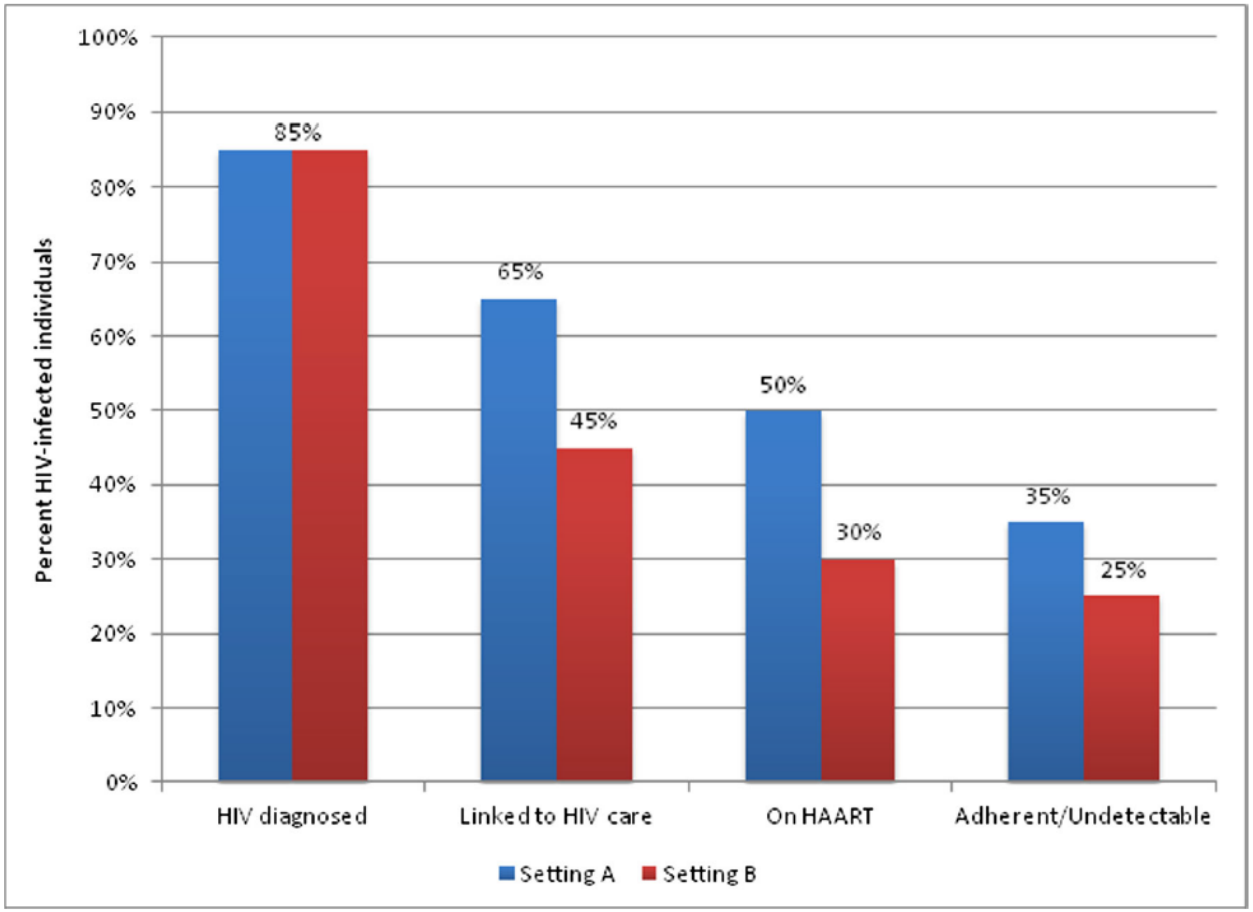


Fig. 1 Cascades of HIV care for two hypothetical settings

Nosyk B et al. Cost-effectiveness Analysis Along the Continuum of HIV Care: How Can we Optimize the Effect of HIV Treatment as Prevention Programs? Curr HIV/AIDS Rep. 2014 Dec; 11(4): 468-78

Model to estimate the number of secundary cases by year integrated with the variable rate of transmission at the different steps of the continuum of care

Population of 20 000 HIV positive patients

diagnosed	Retained in care	treated	Undetecta-ble VL	proportion	Number of patients	Rate of transmis-sion *	Number of secondary cases
No	No	No	No	15%	3000	0,1117	353
Yes	No	No	No	10%	2000	0,0484	97
Yes	Yes	No	No	10%	2000	0,02	40
Yes	Yes	Yes	No	10%	2000	0,005	10
Yes	Yes	Yes	Yes	55%	11000	0	0

Total of secondary cases: 500

*Rate of transmission adapted from: Hutchinson A et al. Return on Public Health Investment: CDC's Expanded HIV Testing Initiative. JAIDS. Vol 59, n°3, March 1, 2012: 281-286.

Factors to take into account in the evaluation of the cost of the management of HIV infection

- **Extra-costs due to new cases**
- **Cost of medical care**
  - Cost of **hospitalisation** (high in case of opportunistic infections: solution: earlier diagnosis)
  - Cost of **treatment** (± 165 millions euros)*
  - Cost of **complementary examen** (laboratory,…)
  - Cost of **human resources** (ARC: 6,2 millions euros + medical consultations)
- **Cost of disability**
  - Reversible (secondary effects of drugs, depression,…)
  - Non reversible (sequelaes of opportunistic infections, comorbidities,…)
- **Cost of unemployment**

* Vandijck D. HIV combinatietherapie kost 1027,5 euro per patient per maand: http://www.uhasselt.be/UH/Tijdschriften/ToonPersmededeling.html?i=727

Model to estimate the costs at the different steps of the continuum of care

diagnosed	Retained in care	treated	Undetecta-ble VL	Potential costs		
				Secundary infections	Opportunistic infection/hospitalisa-tion/ disability	HAART
No	No	No	No	++++	+++	-
Yes	No	No	No	+++	++	-
Yes	Yes	No	No	++	+	-
Yes	Yes	Yes	No	+	-	++
Yes	Yes	Yes	Yes	-	-	++

Cost-effectiveness of society level strategies

Plus d'inégalités de revenus c'est plus de VIH/sida
Plaidoyer pour des coefficients de Gini en dessous de 0,3

More income inequalities means more HIV-AIDS
An advocacy for Gini coefficients beside 0.3

- The Gini coefficient is a measurement of the income distribution of a country's residents. 0 represents perfect equality, 1 perfect inequality.
- Correlation between the Gini coefficient and the prevalence of HIV/AIDS:

Gini coefficient:

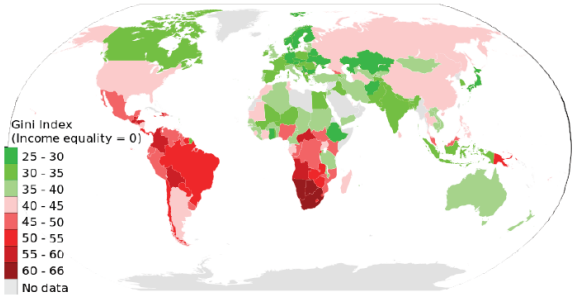
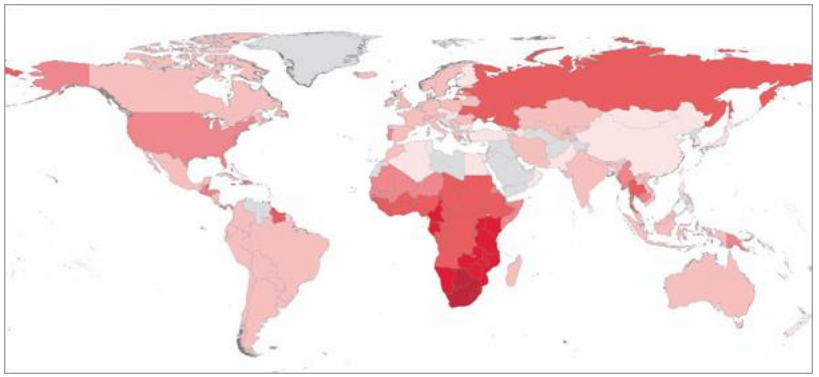


Figure 6 – Indicateur d'inégalité Gini par pays. Source : à partir des données de la Banque Mondiale, 2014[4].

HIV prevalence:



Livinec B, Kaboré S. Plus d'inégalités de revenus c'est plus de VIH/SIDA. Plaidoyer pour des coefficients de Gini en dessous de 0,3. Médecine et Santé Tropicales 2015 Apr-Jun; 25 (2): 118-21.

State variation in HIV/AIDS health outcomes: the effect of spending on social services and public health

Kristina M. Talbert-Slagle, Maureen E. Canavan, Erika M. Rogan, Leslie A. Curry and Elizabeth H. Bradley

Results: States with higher spending on social services and public health per person in poverty had significantly lower HIV and AIDS case rates and fewer AIDS deaths, both in 1 and 5 years post expenditure (p≤0,05).

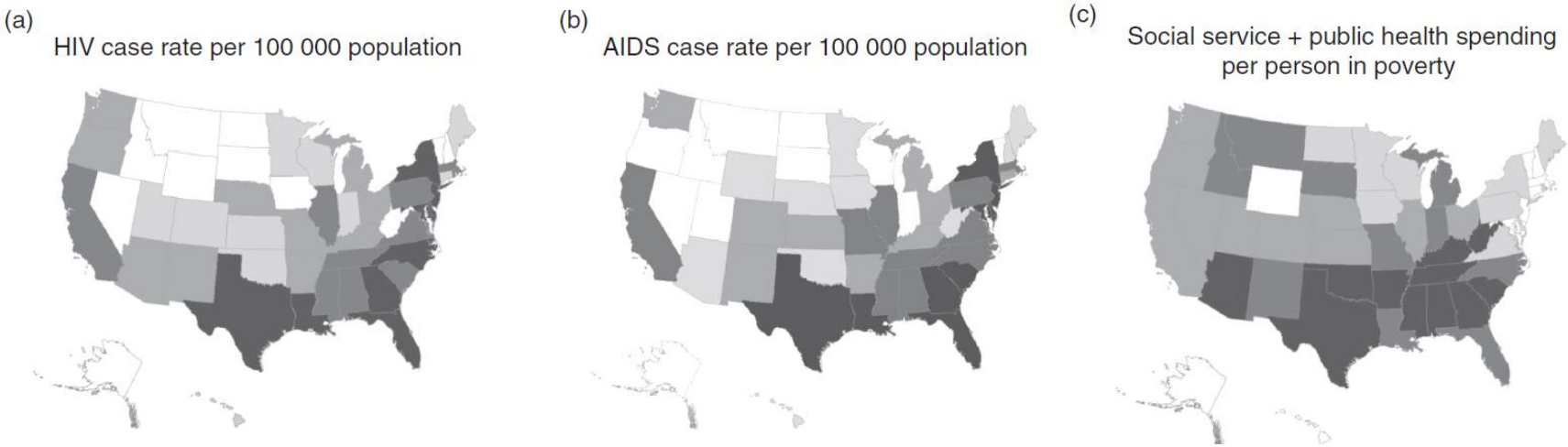


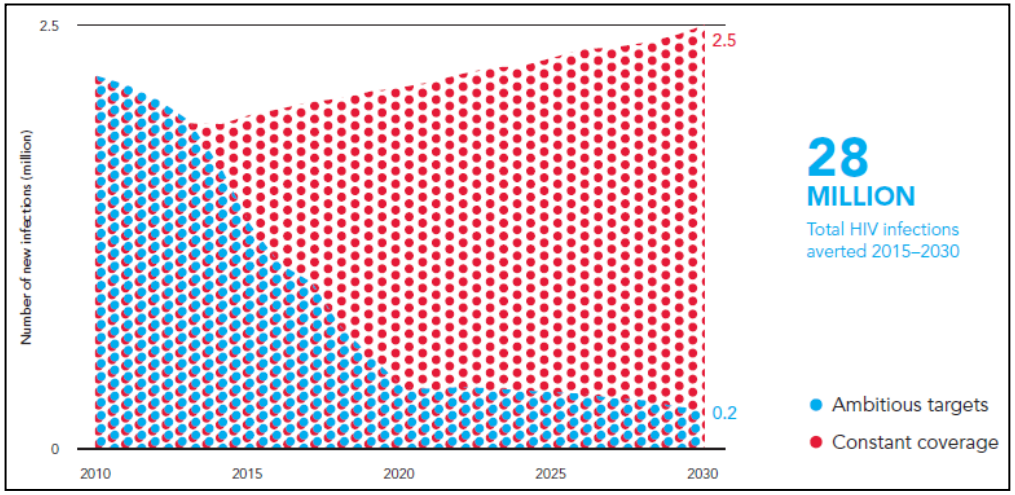
Fig. 1. U.S. maps of HIV/AIDS case rates and combined social service and public health spending per person in poverty, 2009. (a, b) Dark gray indicates highest quintile (i.e. poorest health outcomes) and white indicates lowest quintile (i.e. best health outcomes). (c) Dark gray indicates lowest social service + public health spending per person in poverty; white indicates highest social service + public health spending per person in poverty.

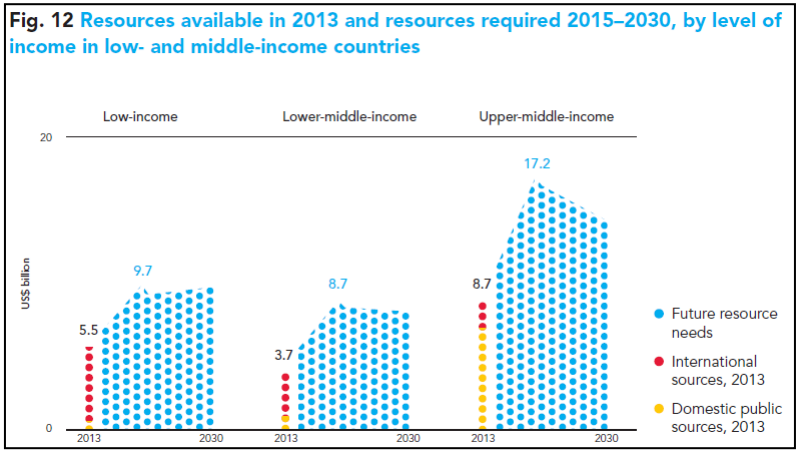
Talbert-Slagle K et al. State variation in HIV/AIDS health outcomes: the effect of spending on social services and public health. AIDS 2016, 30: 657-663.

Cost-effectiveness of the UNAIDS global strategy 95-95-95 by 2030

UNAIDS: objectives 95-95-95 by 2030

- « When combining elements of full income, productivity growth and savings on medical care spending, preliminary estimates indicate that the **total benefits are fifteen times larger than the costs** to implement the ambitious new targets by 2030 ».





Benefits and Costs of the HIV/AIDS Targets for the Post-2015 Development Agenda. Post-2015 Consensus. Joint United Nations Programme on AIDS (UNAIDS).
Fast track: Ending the AIDS epidemic by 2030: www.unaids.org

Conclusions

Actual costs of HIV management depend first of all on the prices of antiretroviral drugs (± 90%):

$\Rightarrow$ Reduction of prices has to be discussed with industry.

$\Rightarrow$ The most efficient ART combination has to be elected by the HIV clinicians for each patient.

Conclusions

- The future costs of HIV management depend on the number of new HIV infections that will occur. To limit this number we need:
  - More prevention
  - Earlier diagnoses
  - More patients on treatment (lower community viral load)
  - Less patients lost to follow-up
  - less patients excluded from social services (migrants,…)
  - To maintain and improve the follow-up in the AIDS Reference Centres and by the general practitioner

=> We must invest in human resources to improve the management of the HIV epidemic

Thank you for your attention

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Sabine Demoulin (nurse)
Laurence Moons (psychologist)
Isabelle Zorzetto (secretary)

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Rudi Gooris
Tharcisse Niyongira
Serin Gunes

BREACH
Belgian Research AIDS&HIV Consortium

C.H.U. *de Charleroi*
Centre de Référence Sida