HIV/AIDS cost-effectiveness: clinical / in practice

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CHU de Charleroi
5th BREACH Symposium
25th of November 2016
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.
Reproduction number ($R_0$)

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

Where can we act?

- $R_0 = BcD$
  - Probability of infection per contact
  - Number of contacts in a given time period
  - Duration of infectivity

Estimation of transmission rates

<table>
<thead>
<tr>
<th>Transmission rates</th>
<th>Rate</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual aware, not on ART annual transmission</td>
<td>0.0484</td>
<td>Prabhu et al²⁰</td>
</tr>
<tr>
<td>Sexual aware, on ART annual transmission</td>
<td>0.0097</td>
<td>Prabhu et al²⁰ (calculated)</td>
</tr>
<tr>
<td>Sexual unaware annual transmission</td>
<td>0.1117</td>
<td>Prabhu et al²⁰ (calculated)</td>
</tr>
<tr>
<td>IDU aware annual transmission</td>
<td>0.126</td>
<td>Sanders et al¹³, Zaric et al²¹</td>
</tr>
<tr>
<td>IDU unaware annual transmission</td>
<td>0.165</td>
<td>Sanders et al¹³, Zaric et al²¹</td>
</tr>
</tbody>
</table>

- **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
    - ...

Cost-effectiveness of interventions

Cost/QALY: 1 - 3 x GDP per capita

Cost

Health effect (QALYs)

Current care

NOT cost effective

Cost effective

Return on investment

Intervention doesn’t save money but improves health with a cost per QALY below the decided threshold

Intervention saves money

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.

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, \textbf{194-816 HIV infections would be averted} => cost per infection averted: 51601-61302 $.
  – Contrasted with HIV treatment cost savings alone, the rate of financial \textbf{return on investment would be 7,58-6,38}.

HIV-1 Outbreak among Drug Injectors in Athens

- 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.

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).


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.

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.

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, Rolanda Barrios, Berita Yip, Ewen Wood, Thomas Kerr, Kate Shannon, P Richard Harrigan, Robert S Hogg, Patrick Dely, Perry Kendall

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


Cost-effectiveness: the continuum of care
Comparison of continuum of care: Belgium - USA

10 to 20% of undiagnosed PLWHIV


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

10 to 20% of undiagnosed PLWHIV


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
Continuum of care

Model to estimate the number of secondary 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

<table>
<thead>
<tr>
<th>diagnosed</th>
<th>Retained in care</th>
<th>treated</th>
<th>Undetectable VL</th>
<th>proportion</th>
<th>Number of patients</th>
<th>Rate of transmission *</th>
<th>Number of secondary cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>15%</td>
<td>3000</td>
<td>0,1117</td>
<td>353</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>10%</td>
<td>2000</td>
<td>0,0484</td>
<td>97</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>10%</td>
<td>2000</td>
<td>0,02</td>
<td>40</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>10%</td>
<td>2000</td>
<td>0,005</td>
<td>10</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>55%</td>
<td>11000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total of secondary cases: 500

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**

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

<table>
<thead>
<tr>
<th>diagnosed</th>
<th>Retained in care</th>
<th>treated</th>
<th>Undetectable VL</th>
<th>Potential costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Secundary infections</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>++++</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>+++</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>++</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>+</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
</tbody>
</table>
Cost-effectiveness of society level strategies
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:

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).

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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 ».

Conclusions

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

⇒ Reduction of prices has to be discussed with industry.

⇒ 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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Association SIDA/IST Charleroi:
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