Modelling the Impact and Economics of 90-90-90

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UNAIDS Report

- Reached 70-77-82
- On track to reach 90-90-90
- End AIDS by 2030
- Does not mean the end of HIV
- End-game is always the hardest part
To get effective global, national and local action we need...

Data
  Natural history; social context; financial

Interpretation and analysis
  Biology, sociology and statistics

Estimates and projections
  Dynamical models, epidemiology, economics
Dramatic decline in transmission before ART roll-out

Ethiopia

Prevalence in adults 15+ yrs

1980 2000 2020 2040

HIV

ART

Transmission
HIV-drives TB in Botswana

HIV+ and ART regions are highlighted.

https://tinyurl.com/BGW0002
Transmission Network: Can Tho, Vietnam

R0 = 11.0

LRW: low risk women
IDU: intravenous drug users
MCF: male clients of female sex workers
MSM: men who have sex with men
FSW: female sex workers

Transmission network: Can Tho, Vietnam

http://tinyurl.com/BGW0003
South Africa

- Good trend data
- Good costing data
- Biggest epidemic in the world
<table>
<thead>
<tr>
<th>Service</th>
<th>2016 Cost (US$)</th>
<th>2017 Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Testing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32 per test</td>
<td>120 p.a.</td>
</tr>
<tr>
<td>Health off ART</td>
<td>1 25 p.a.</td>
<td>1 48 p.a.</td>
</tr>
<tr>
<td></td>
<td>2 51 p.a.</td>
<td>2 54 p.a.</td>
</tr>
<tr>
<td></td>
<td>3 63 p.a.</td>
<td>3 106 p.a.</td>
</tr>
<tr>
<td></td>
<td>4 108 p.a.</td>
<td>4 132 p.a.</td>
</tr>
<tr>
<td>Condoms</td>
<td>5 p.p.a.</td>
<td>Deaths 1136 p. death</td>
</tr>
<tr>
<td>TB treat.</td>
<td>780 p. case</td>
<td>Disc. rate 0.03 p.a.</td>
</tr>
</tbody>
</table>
Drug costs (US$ p.p. p.a.)

South Africa

1980  2000  2020  2040
What if we had started at 500/μL in 2000?

HIV in South Africa

Adults 15+

Starting in 2000
Targets Workshop | July 22-23 • Paris

Current strategy  
Save US$2.5Bn 1.0M deaths  
90-90-90

HIV in South Africa  
Adults 15+

90-90-90 Targets Workshop | July 22-23 • Paris

US$ 70 Bn 6.8 M deaths

$4k/death averted

What will it all cost?
South Africa

Cost and impact: 2015 to 2050

New infections (M)
- Current Strategy: 5.00
- +90-90-90: 1.24
- +VMMC: 1.17
- +PrEP: 1.12
- +Condom: 1.09

Deaths (M)
- Current Strategy: 1.66
- +90-90-90: 0.52
- +VMMC: 0.51
- +PrEP: 0.51
- +Condom: 0.51

Cost (Bn US$)
- Current Strategy: 55.5
- +90-90-90: 52.3
- +VMMC: 53.0
- +PrEP: 57.8
- +Condom: 58.0
What we really need is much better data
ANC surveillance (2017)

1. Ask about status
2. HIV
3. ARV
4. Viral load
5. Recent infection
6. Drug resistance
7. Other STIs
8. TB

Cost ~ 0.1% of current annual expenditure
<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested</td>
<td>141,212</td>
</tr>
<tr>
<td>Already infected</td>
<td>10,766</td>
</tr>
<tr>
<td>Starting ART</td>
<td>25,957</td>
</tr>
<tr>
<td>Number on ART and alive</td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>519,063</td>
</tr>
<tr>
<td>Children</td>
<td>49,407</td>
</tr>
<tr>
<td>ART coverage (%)</td>
<td>57</td>
</tr>
<tr>
<td>Survival on ART at 12 months</td>
<td></td>
</tr>
<tr>
<td>Adults (%)</td>
<td>79</td>
</tr>
<tr>
<td>Children (%)</td>
<td>78</td>
</tr>
<tr>
<td>HIV+ pregnant women on ART</td>
<td>10,460</td>
</tr>
<tr>
<td>HIV exposed infants on ARV prophylaxis</td>
<td>7,771</td>
</tr>
</tbody>
</table>
Cost of Malawi’s patient monitoring

~ 1% of current expenditure
18.5k deaths
75% young, HIV+ adults
9 HIV+ deaths/day
Cost US$160k p.a.

HIV+ Deaths in Baragwanath 2006–2009

http://tinyurl.com/BGW0022
The fault, dear colleagues, lies not in our models but in our data.

With apologies …
Facility-based treatment cost (CHAI)

<table>
<thead>
<tr>
<th>Country</th>
<th>ARV</th>
<th>Pers.</th>
<th>Labs</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi</td>
<td>66</td>
<td>29</td>
<td>5</td>
<td>36</td>
<td>136</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>103</td>
<td>28</td>
<td>16</td>
<td>39</td>
<td>186</td>
</tr>
<tr>
<td>Rwanda</td>
<td>114</td>
<td>67</td>
<td>15</td>
<td>37</td>
<td>232</td>
</tr>
<tr>
<td>Zambia</td>
<td>155</td>
<td>73</td>
<td>13</td>
<td>37</td>
<td>278</td>
</tr>
<tr>
<td>RSA</td>
<td>181</td>
<td>334</td>
<td>102</td>
<td>65</td>
<td>682</td>
</tr>
</tbody>
</table>
Can Tho: Vietnam

Big circle
Group size

Small circle
No. infected

http://tinyurl.com/BGW0003
Concentrated HIV epidemics: Can Tho, Vietnam

Prevalence varies greatly
Group size varies greatly
Some groups overlap

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>%</th>
<th>Pos.</th>
<th>HIV prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDU</td>
<td>3157</td>
<td>46</td>
<td>1446</td>
<td>0.6</td>
</tr>
<tr>
<td>FSW</td>
<td>2034</td>
<td>5.4</td>
<td>109</td>
<td>0.4</td>
</tr>
<tr>
<td>MSM</td>
<td>1492</td>
<td>8.8</td>
<td>131</td>
<td>0.1</td>
</tr>
<tr>
<td>MCF</td>
<td>62k</td>
<td>1.0</td>
<td>615</td>
<td>0.06</td>
</tr>
<tr>
<td>LRW</td>
<td>454k</td>
<td>0.4</td>
<td>1776</td>
<td>0.005</td>
</tr>
</tbody>
</table>

IDU: intravenous drug users
FSW: female sex workers
MSM: men who have sex with men
MCF: male clients of female sex workers
LRW: low risk women

http://tinyurl.com/BGW0003
Show us the money (US$)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>People infected with HIV</td>
<td>36M</td>
</tr>
<tr>
<td>People on ART</td>
<td>15M</td>
</tr>
<tr>
<td>Current investment p.a.</td>
<td>$22B</td>
</tr>
<tr>
<td>Current investment/PLWH p.a.</td>
<td>$600</td>
</tr>
<tr>
<td>Cost of ARV p.a.</td>
<td>$100</td>
</tr>
<tr>
<td>Admin, Care, PrEP, VMMC etc.</td>
<td>$500</td>
</tr>
</tbody>
</table>
Affordability at US$500/person p.a.

With international support, universal access to ART is affordable in Africa

http://tinyurl.com/BGW0015
Zibambele: Fixing roads, improving health, alleviating poverty

David Ginsburg and Peter Derman

Launched in 2000 by the KZN Department of Transport to maintain designated strips of gravel road.

Women headed households, no male support or other income

2010: 40k households were receiving R460 (US$30) per month

US$1.2 million paid monthly to the poorest families in the province: 93% to the women; 7% to manage the project

Improvements in household nutrition, people able to pay school fees. Collective savings in excess of US$1 million

Invested in small-scale enterprises creating jobs and injecting cash into impoverished rural communities.