Program Science – Approaches to Maximize Return on Investment in HIV Prevention

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The widening HIV financing gap

Improve:
Allocative Efficiency

Strengthen epidemiological intelligence through disease burden analysis, targeted surveillance, integrative synthesis studies and better prioritized strategic planning in order to improve the allocation of scarce AIDS resources, among alternative geographic, target group, disease and intervention priorities.

Improve:
Technical Efficiency

Program management analysis, health systems integration studies, program expenditure tracking and cost-effectiveness research to improve the flow, and use of resources and intervention delivery options and mix in order to promote efficient resource management and program implementation.

Improve:
Sustainability

Strengthen and diversify financing to ensure an efficient, effective, robustly financed AIDS program.

Improve:
Effectiveness

Impact evaluation to establish what works, disseminate proven practice and improve program effectiveness.
Allocative and technical efficiency: the South African conundrum

- Condoms
- VCT
- PMTCT
- Treatment
Technical efficiency starts with service unit costs

Unit Costs for Delivering ART

Source: CHAI, 2011
Reducing unit cost drivers: idle staff time
Reducing unit cost drivers: staffing model

Rwanda – Heavily nurse centered model with roving doctor supporting multiple sites. Heavy use of CHWers

Malawi – Clinical officers are playing the doctor’s role in all HC’s, and admin clerks are acting as nursing assistants

Ethiopia – Cost driven primarily by nurses and pharmacists. Private facilities have heavier staffing levels leading to higher cost

Zambia – Preliminary data indicates a wide variety of models being used
Reducing unit cost drivers: too much equipment

<table>
<thead>
<tr>
<th>Component</th>
<th>Rwanda</th>
<th>Malawi</th>
<th>Ethiopia</th>
<th>Zambia</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD4 Unit Cost</td>
<td>$6.28</td>
<td>$7.21</td>
<td>$7.11</td>
<td>$6.20</td>
<td>$8.42</td>
</tr>
<tr>
<td>Personnel</td>
<td>$3.00</td>
<td>$8.11</td>
<td>$0.49</td>
<td>$2.19</td>
<td>$ -</td>
</tr>
<tr>
<td>CD4 Machine</td>
<td>$0.69</td>
<td>$19.21</td>
<td>$1.99</td>
<td>$2.30</td>
<td>$ -</td>
</tr>
<tr>
<td>Buildings</td>
<td>$ -</td>
<td>$0.32</td>
<td>$0.06</td>
<td>$0.19</td>
<td>$0.10</td>
</tr>
<tr>
<td>Running Costs</td>
<td>$0.70</td>
<td>$9.19</td>
<td>$0.15</td>
<td>$0.39</td>
<td>$0.28</td>
</tr>
<tr>
<td>Training</td>
<td>$0.25</td>
<td>$ -</td>
<td>$0.17</td>
<td>$0.33</td>
<td>$ -</td>
</tr>
<tr>
<td>Total</td>
<td>$10.93</td>
<td>$44.04</td>
<td>$9.98</td>
<td>$11.59</td>
<td>$8.79</td>
</tr>
</tbody>
</table>

- Fully loaded cost of CD4 test is high in Malawi. Driven by installed capacity of 1.5 million test per year running 180,000 tests per year.
- Low availability of sample transport a real barrier to improved utilization, which would reduce price per test significantly.
Sustainability: In Africa, only South Africa and Botswana finance their own AIDS programs

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Total (US$ millions)</th>
<th>% of GDP</th>
<th>Per capita (US$)</th>
<th>External financing (% of total)</th>
<th>GDP per capita (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>2009</td>
<td>33.7</td>
<td>0.05</td>
<td>1.9</td>
<td>n.a.</td>
<td>3,972</td>
</tr>
<tr>
<td>Botswana</td>
<td>2008</td>
<td>348.1</td>
<td>2.6</td>
<td>194.4</td>
<td>32.1</td>
<td>7,552</td>
</tr>
<tr>
<td>Congo, Dem. Rep. of</td>
<td>2008</td>
<td>96.4</td>
<td>0.8</td>
<td>1.5</td>
<td>86.0</td>
<td>184</td>
</tr>
<tr>
<td>Lesotho</td>
<td>2008</td>
<td>56.4</td>
<td>3.6</td>
<td>22.9</td>
<td>53.1</td>
<td>645</td>
</tr>
<tr>
<td>Madagascar</td>
<td>2008</td>
<td>12.0</td>
<td>0.1</td>
<td>0.6</td>
<td>54.7</td>
<td>468</td>
</tr>
<tr>
<td>Malawi</td>
<td>2008</td>
<td>107.4</td>
<td>2.6</td>
<td>7.8</td>
<td>97.6</td>
<td>298</td>
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<td>Mauritius</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
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<tr>
<td>Mozambique</td>
<td>2008</td>
<td>146.4</td>
<td>1.5</td>
<td>7.1</td>
<td>95.6</td>
<td>478</td>
</tr>
<tr>
<td>Namibia</td>
<td>2007</td>
<td>18.5</td>
<td>0.2</td>
<td>9.1</td>
<td>49.2</td>
<td>4,341</td>
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<tr>
<td>Seychelles</td>
<td>2009</td>
<td>0.6</td>
<td>0.1</td>
<td>6.8</td>
<td>19.4</td>
<td>8,973</td>
</tr>
<tr>
<td>South Africa</td>
<td>2009</td>
<td>2,088.0</td>
<td>0.7</td>
<td>42.3</td>
<td>27.3</td>
<td>5,824</td>
</tr>
<tr>
<td>Swaziland</td>
<td>2006</td>
<td>48.5</td>
<td>1.8</td>
<td>47.7</td>
<td>61.3</td>
<td>2,698</td>
</tr>
<tr>
<td>Tanzania</td>
<td>2008</td>
<td>465.0</td>
<td>2.3</td>
<td>11.7</td>
<td>98.1</td>
<td>519</td>
</tr>
<tr>
<td>Zambia</td>
<td>2008</td>
<td>279.3</td>
<td>2.6</td>
<td>23.5</td>
<td>97.1</td>
<td>901</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>2009</td>
<td>54.1</td>
<td>1.2</td>
<td>4.6</td>
<td>69.8</td>
<td>375</td>
</tr>
<tr>
<td>Total (latest years)</td>
<td></td>
<td>3,745.5</td>
<td>0.8</td>
<td>14.7</td>
<td>49.9</td>
<td>1,782</td>
</tr>
</tbody>
</table>
The three core HIV prevention questions we want program science to help us answer

- **Where** do new HIV infections come from?

- **What** proven, feasible interventions do we have for each major source of new infections?

- **How** do we implement, monitor and evaluate the delivery of proven feasible interventions for each major source of new infections?
The role of program science

• The first duty of program science
  • Knowing our epidemics
  • Understanding our last 1,000 infections
  • Understanding transmission dynamics

• And fundamentally, making sure the money follows the epidemic and the interventions follow the evidence
Global epidemic diversity

• Insufficient recognition of global epidemic diversity
Transmission sources vary widely by region

AF  CAR  EE  ASIA  LA

Heterosexual  MSM  IDU  MTCT
Women a majority of those infected in one region - Africa

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>N America</td>
<td>21</td>
</tr>
<tr>
<td>W Europe</td>
<td>27</td>
</tr>
<tr>
<td>E Asia</td>
<td>27</td>
</tr>
<tr>
<td>Oceania</td>
<td>30</td>
</tr>
<tr>
<td>E Europe</td>
<td>31</td>
</tr>
<tr>
<td>L America</td>
<td>32</td>
</tr>
<tr>
<td>S/SE Asia</td>
<td>37</td>
</tr>
<tr>
<td>Caribbean</td>
<td>50</td>
</tr>
<tr>
<td>Africa</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>
Global epidemic diversity

• Southern Africa only region of world where HIV is existential threat:
  • Southern Africa - 2% of world population and over 33% of HIV infections
  • Almost 1 in 5 people with HIV globally South African

Remarkable epidemic diversity - era of standard global prevention guidance truly over

No single set of prescriptions relevant across, say, South Africa, Ukraine and PNG
Core program science focus on epidemic typologies

- Core program science distinction between CONCENTRATED and GENERALIZED epidemics
- Not based on arbitrary prevalence thresholds, but transmission patterns

- Epidemics CONCENTRATED if protecting SW, MSM, IDU would prevent wider epidemic
- Epidemics GENERALIZED if epidemics would persist despite effective SW, MSM, IDU programmes
Most HIV epidemic are concentrated

- Improved surveillance shows HIV outside Southern Africa lower – and more concentrated
Most epidemics globally are concentrated.
Asian epidemic are not driven by the general population.
Can we respond effectively?

• Once we better understand our epidemics, can we respond effectively with proven approaches?

• Experience sobering in both concentrated and generalized epidemics
Addressing concentrated SW epidemics

• Consider concentrated epidemics initiated by SW

• Asian epidemics are only initiated by sex work if:
  • Men uncircumcised
  • Many men visit sex workers (> 10%)
  • Sex workers have many clients (> 20 weekly)

• Thus, first wave of epidemics in Asia - Thailand, Cambodia, India (outside North East) – largely ignited by SW
HIV prevalence by percentage of men visiting sex workers, Asia
HIV prevalence by number of clients per sex worker

- Mumbai, 1997
- Cambodia, brothel based 1997
- Hanoi, 2006 (17% of sex workers in Hanoi inject drugs)
- Mumbai, 2006
- East Timor, 2003
- Bangkok, non-brothel, 1994
- Da Nang, 2006
- Indonesia, 2004
- Sichuan, 2004
- Bangkok, brothel, 1994
• Concentrated SW epidemics - know what to do in real world at scale

• Have successfully checked numerous SW epidemics in virtually all regions – perhaps the most robust single prevention success
However, the complexity of sex work in Africa poses a challenge

Clients per week

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Seats</th>
<th>Roamers</th>
<th>Bar waitresses</th>
<th>Mobile traders</th>
<th>Students selling sex</th>
<th>Beer brewers/sellers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional, self-identifying</td>
<td>28</td>
<td>18</td>
<td>40%</td>
<td>37%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Non self-identifying</td>
<td>2-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
And concerted SW investments are elusive.
We know the elements of effective SW interventions

- Effective SW programs have six tightly interconnected components:
  - Behavior change communication usually through peer education
  - Condom promotion and provision
  - Tailored sexual health services
  - HIV testing and counseling
  - Solidarity and group empowerment
  - A supportive local and national legal environment
Addressing concentrated IDU epidemics

• Throughout Asia and Eastern Europe, IDU drives HIV, directly and by injecting HIV into commercial sex networks

• Injecting drug use the spark plug that ignites sexual transmission, sex work the engine that maintains it

• European and Asian data shows how injecting drug use fuels HIV in sex work, fundamentally amplifying epidemic potential

• Eastern Europe, Central Asia, Iran, Afghanistan, Pakistan, Indonesia, Philippines lands of opportunity - effective IDU programs can radically curtail sexual epidemics
Initiators of HIV epidemics in Asia

- Mainly SW initiated
- Mainly IDU initiated
- Mainly MSM

Legend:
- Green: Mainly SW initiated
- Yellow: Mainly IDU initiated
- Red: Mainly MSM
HIV prevalence among IDU in Asia

- Afghanistan: 3.40%
- Malaysia: 10.30%
- Pakistan: 10.80%
- India: 11.20%
- China: 12.30%
- Taiwan: 13.80%
- Iran: 15%
- Cambodia: 22.80%
- Vietnam: 33.80%
- Nepal: 41.90%
- Indonesia: 42.00%
- Thailand: 42.50%
- Burma: 42.60%
HIV higher in SW who inject drugs in Vietnam

The graph shows the correlation between HIV prevalence and the percentage of sex workers who inject drugs in Vietnam. The cities mentioned are Da Nang, An Giang, HCMC, Quang Ninh, Hai Phong, and Can Tho.
Addressing concentrated IDU epidemics

- Yet real world experience discouraging
- Can we keep saying that harm reduction works, for example, in former Soviet Union or Asia, when we can’t convince authorities it is preferable to coercion?
- Limited progress towards large-scale harm reduction programs in Asia, with partial exception of substitution therapy in China
- Yet, if we can increase programs, we have inherent advantages - unlike condoms, which inhibit spontaneity, no-one WANTS to share dirty needles
Access to opioid substitution therapy in Eastern Europe and China

Number of OST recipients per 100 IDU

- Hungary: 20
- Czech Rep: 17
- Croatia: 13
- Lithuania: 10
- Estonia: 7
- Moldova: 6
- Slovakia: 3
- Kyrgyzstan: 3
- Ukraine: 2
- Georgia: 1
- Belarus: 1
- Kazakhstan: 1
- Tajikistan: 1
- Turkmenistan: 0
- Uzbekistan: 0
- Russia: 0
- Armenia: 0
Addressing concentrated MSM epidemics

- Greatly underestimated contribution of MSM to HIV transmission in developing countries
MSM epidemics may incubate slowly then surge.

- **HIV virus is introduced into the MSM population in the year 2000.**
- **HIV prevalence starts appreciable growth in the MSM population around the year 2010.**
HIV prevalence among MSM in Latin America

HIV Prevalence (%)

- Mexico
- Trinidad & Tobago
- Bolivia
- Colombia
- Uruguay
- Ecuador
- Brazil
- Honduras
- Paraguay
- Peru
- Argentina
- Guatemala
- Panama
- Nicaragua
- El Salvador
- Puerto Rico

MSM
Population

Population

HIV Prevalence (%)
HIV prevalence far higher in MSM than FSW in Latin America

- Argentina: Buenos Aires (8.0%), Provinces (7 cities) (6.0%)
- Bolivia: La Paz (0.0%), Santa Cruz (6.0%), Border cities with Argentina (6.0%)
- Chile: Santiago (0.0%)
- Colombia: Bogotá (6.0%)
- Ecuador: Quito (6.0%), Guayaquil (23.0%), Other city ports (4) (6.0%)
- Paraguay: Asunción and 4 other cities (8.0%)
- Peru: Lima (6.0%), Provinces (6.0%)
- Uruguay: Montevideo (23.0%), Border cities with Brazil (6.0%)
- Venezuela: Isla Margarita (0.0%)

% HIV prevalence

- Female sex workers
- Men who have sex with men
HIV prevalence among MSM in Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>HIV Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>25</td>
</tr>
<tr>
<td>India</td>
<td>15</td>
</tr>
<tr>
<td>Indonesia</td>
<td>10</td>
</tr>
<tr>
<td>Cambodia</td>
<td>7</td>
</tr>
<tr>
<td>Nepal</td>
<td>5</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3</td>
</tr>
<tr>
<td>China</td>
<td>2</td>
</tr>
<tr>
<td>East Timor</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Red** represents MSM
- **Green** represents Population
HIV prevalence among MSM in China
HIV prevalence among MSM in Chongqing, China
HIV prevalence among MSM in Sichuan, China

0.6
1
1.3
4.6
10.6

2003 2004 2005 2006 2007
HIV prevalence among MSM in Africa

![Graph showing HIV prevalence among MSM in Africa]
HIV PREVALENCE AND INCIDENCE AMONG FSW AND MSM IN MOMBASA, KENYA

<table>
<thead>
<tr>
<th></th>
<th>MSM</th>
<th>FSW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>23</td>
<td>32</td>
</tr>
<tr>
<td>Incidence</td>
<td>8.6</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Addressing concentrated MSM epidemics

- Despite developed world successes, few developing country MSM programs have demonstrably reduced HIV incidence.
- In developing countries, know little about how to reach hidden MSM, reduce stigma, effect policy change and manage large-scale programs.
- Easier in contexts open to homosexuality, such as India or Nepal – than more repressive contexts.
- Still need to navigate between southern unwillingness to address male-male sexuality and northern temptation to frame response within western constructs of limited relevance to developing countries.
Let’s remind ourselves what generalized epidemics look like
Estimated National Adult HIV Prevalence: 16.5%

Zambia: Relative Proportion of Incident Cases (modeled)
Household HIV prevalence in Francistown, Botswana

![Bar Chart]

- **Male**
- **Female**

Age groups: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49
Addressing generalized epidemics

• Do we have proven interventions in generalized epidemics?

• Consider this updated familiar summary of 49 HIV prevention randomized controlled trials, including 37 completed/stopped studies, with HIV incidence end-points
## Results of HIV prevention trials

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Number</th>
<th>Completed/Stopped</th>
<th>Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbicides</td>
<td>12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Behavior change</td>
<td>9</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>STI treatment</td>
<td>8</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>HIV vaccines</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>PEP</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Male circumcision-male acquisition</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>HIV treatment as prevention</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PREP</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>37</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>
Addressing generalized epidemics

• Four major challenges

• First, many trusted interventions – treatment of sexually transmitted infections, testing and counseling, school and youth programs, condom promotion - at best unproven, at worst disproven, for reducing HIV incidence
Second, best proven intervention, male circumcision, barely advancing - since 3 trials were terminated early 2 years ago, few extra men protected.

Yet immense potential – 7 of 8 highest prevalence countries globally have male circumcision rates below 20% and expanding safe circumcision services in these countries could prevent 2+ million deaths.

In countries such as Zambia, with 15% adult HIV prevalence and a billion dollars in annual AIDS financing, little funding for male circumcision, despite growing waiting lists at public facilities.
Addressing generalized epidemics

• Third, major contributor to reduced HIV transmission in generalized epidemics is partner reduction – have seen this in country after country

• Yet, partner reduction investment, implementation and evaluation still neglected
Kenya’s changes ... but have programmes contributed?

Percent of Men with 2 or More Partners, Kenya 1993-2008
(In last 6 months for 1993, in last 12 months for 1998 and 2008)

HIV incidence and behavior change in Zimbabwe

Impact – incidence changes

HIV incidence (per 100,000)

Year

Proximate factors

Starting sex
Multiple partnerships
Condom use

15-19s men had sex [DHS]
15-19s women had sex [DHS]
Men with extra-marital partners [DHS]
Men paid for sex last year [DHS]
Men with multiple concurrent partners [Manicaland]
Men with casual partners in last month [Manicaland]
Men using condom at last casual sex [DHS]

Late 1990s
Early/Mid 2000s

%
Fourth, what do we do about ART-based prevention, including treatment as prevention and PREP? How do we establish real world effectiveness, finance it and balance ART-based prevention with obligation to treat the sick?
Conclusion – why program science matters so much

• CONCENTRATED SW epidemics preventable, but protecting MSM and IDU in developing countries requires new and creative approaches

• In GENERALIZED epidemics, core challenge to reallocate resources from unproven or disproven approaches to proven but sensitive approaches - male circumcision and partner reduction – and to figure out role of ART-based prevention

• Clear challenge - insufficient effort to align prevention priorities with epidemic transmission dynamics, compromising prevention with mismatched or unfocused responses and insufficient effort to align interventions with evidence

• Global AIDS community slow to implement genuinely proven approaches at adequate scale - with knowledge we already have, far more can be done to curb HIV globally