Efficiency in Health: The role of Decision and Delivery Science
01 Decision Support
02 Delivery Support
03 Evaluation Support
01 DECISIONS

02 DELIVERY

03 IMPACT

Impact: Greatest possible impact on disease burden

Intelligence: Distribution of disease burden

Governance: Distribution of disease burden

Context: Governance

Capacity: Systems

Intervention: Most cost-effective mix of interventions to address disease burden

Investment: Financing for greatest possible health impact

Institutionalization: Governance, Accountability, Systems, Financing

Implementation: Implementing at least cost and best quality
Support countries to:

Make the best possible investment decisions

Generate demand for and deliver services to the best feasible standards:

for the right people

in the right places

at the right time

in the right ways

Achieve the best possible health impact

Plan early to ensure that proven approaches are institutionalized and sustained
## Decision Support

### Examples

<table>
<thead>
<tr>
<th>Example</th>
<th>State of the evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash transfers, education and health:</td>
<td>![Completed]</td>
</tr>
<tr>
<td>![Image of a cross, graduation cap, and credit card]</td>
<td></td>
</tr>
<tr>
<td>Sexual and reproductive health in Africa:</td>
<td>![Planned with PD GSA]</td>
</tr>
<tr>
<td>![Image of Africa with male and female symbols]</td>
<td></td>
</tr>
<tr>
<td>Best buys in non-communicable diseases:</td>
<td>![Planned with HS GSA]</td>
</tr>
<tr>
<td>![Image of a heart with a stethoscope]</td>
<td></td>
</tr>
</tbody>
</table>

### Mathematical optimization

- HIV, TB, nutrition, child health, possibly HCV
- ![Optima logo](https://example.com/optima.png)
Optima mathematical optimization equation

For resource vector $\mathbf{R}$ such that $\sum \mathbf{R} = c(t)$ and bounded by constraints $r_{\text{min}}(t) \leq R_i \leq r_{\text{max}}(t)$ with outcome $0 = f(\mathbf{R})$, find $\mathbf{R}$ that minimizes $0$. 
India AIDS: Interventions

Least optimal allocation—general population nationally

Optimal interventions—targeted behavioral interventions for sex workers in the four highest burden states
Improving prevention allocations in concentrated epidemics
Global transmission: Patterns
Concentrated epidemics: Proven approaches for SW, MSM and IDU

- Behavior change communication
- Condom and NSP promotion
- Tailored sexual health and OST services
- Supportive local and national legal environment
- Solidarity and group empowerment
- HIV testing, counseling and treatment
- Effective targeted interventions have seven integrated components
- PrEP
Optimizing: HIV prevention investments
Belarus could reduce new HIV infections by 43%...and deaths by 51% by making the following reallocations:

- ART from US$3.0M to $8.4M
- OST from US$0.7M to $2.8M
- NSP from US$1.1M to $3.6M
Kazakhstan could halve HIV incidence and mortality with existing budget with optimal allocation and reduced ART and management costs.
Improving prevention allocations in generalized epidemics
Generalized epidemics: Why are they so different, Swaziland?

HIV prevalence in Swaziland

- 14 (18-19)
- 7 (20-24)
- 21 (25-29)
- 37 (30-34)
- 54 (35-39)
- 49 (40-44)
- 46 (45-49)

- Male
- Female

Swaziland
Generalized epidemics: Why are they so different?

Sexual partnerships in Swaziland

- Guards: 60% Casual Sex, 0% Commercial sex
- Drivers: 50% Casual Sex, 0% Commercial sex
- Soldiers: 40% Casual Sex, 0% Commercial sex
- Police: 30% Casual Sex, 0% Commercial sex
- Seasonal workers: 20% Casual Sex, 0% Commercial sex

Sexual partnerships in Lesotho

- Soldiers: 80% Casual Sex, 0% Commercial sex
- Miners: 60% Casual Sex, 0% Commercial sex
- Drivers: 40% Casual Sex, 0% Commercial sex
Generalized epidemics: Why are they so different?

Sources of infection example, KwaZulu-Natal (South Africa), 2012

- 1.0% IDUs
- 0.1% Partners of IDUs
- 3% Partners of clients
- 9% Clients
- 6% Sex workers
- 8% MSM
- 0.1% Female partners of MSM
- 11% Casual heterosexual sex
- 4% Partners of casual heterosexual sex

General heterosexual population = 76% of infections

61% Low risk heterosexual
### Generalized epidemics: Proven approaches

<table>
<thead>
<tr>
<th>Trial</th>
<th>Completed/Stopped</th>
<th>Effective</th>
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</thead>
<tbody>
<tr>
<td>Microbicides</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Behavior change</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>STI treatment</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>HIV vaccines</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>PEP</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Male circumcision</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ART-based prevention</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Cash transfers</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
Optimizing an increased budget in Zambia’s generalized HIV epidemic

With a 140% budget optimized as follows, Zambia could achieve the gains below:

- Decrease MTCT proportion
- Decrease BCC 13–0M
- Increase MC 25–55M
- Increase Testing 17–35M
- Increase SW/client 0–10M

Outcomes of spending:

- # Overall infections:
  - Optimized 2012: 29,156, 2016: 29,156

- # Youth infections:
  - Current 2012: 8,555, 2016: 7,513
  - Optimized 2012: 4,482, 2016: 4,482

- # AIDS deaths:
  - Current 2012: 22,545, 2016: 25,185
  - Optimized 2012: 12,411, 2016: 12,411

- % MTCT:
  - Current 2012: 6.4%, 2016: 5.7%
  - Optimized 2012: 3.2%, 2016: 3.2%

- % ART coverage:
  - Current 2012: 84.4%, 2016: 84.1%
  - Optimized 2012: 94.5%, 2016: 94.5%
Impact of optimized allocations on generalized epidemics in Swaziland

Swaziland could reduce new infections by 30% by 2018 by making a single change to allocations: Increase VMMC from <1% to 8% of HIV spending plus sustain and expand ART, PMTCT, BCC, condoms within existing budgets.
Improving geographic prioritization in prevention allocations
Geographical prioritization in Indonesia
Improving geographical prioritization in Malawi

Absolute numbers of PLHIV/new infections per district

Levels of HIV prevalence/incidence per district (%)

Analyze

- 0%
- 1.5%
- 3.0%
- 4.5%
- 6.0%
- 7.5%
- 9.0%
- 10.5%

- 0
- 8,000
- 16,000
- 24,000
- 32,000
- 40,000
- 48,000
- 56,000
- 64,000
Greatest gains by targeting by program and location in Malawi

PLHIV current spending (US$ millions)

Optimal spending (US$ millions)

HIV prevalence per district

Increased spending in this district, particularly ART and PMTC

Decreased spending in this district across all programs

Source: Draft of populated Optima model, not for citation
Develop detailed district level allocation results in Malawi
Optima conference

Annual Optima skills clinic

Optima global network established

Optima HIV completed in 30 countries, including 10 in ECA

Optima HIV partnership with PEPFAR in COPs to influence $15 billion annually

Optima TB being developed and being tested in 5 countries including Belarus

Optima Nutrition planned with Nutrition GSA and global partnership

Optima Child Health feasibility assessment with Service Delivery and Health Financing GSA, GFF, IHME and partners

Optima HCV proposed with Healthy Societies GSA

Decision Science support on request to TTLs
Delivery Support

Examples:

1. Case Studies
2. Implementation Guides
3. Delivery/impact heterogeneity analyses
4. Bottleneck/constraint analyses
5. Measurement for performance improvement with SDI and PHCPI
6. Value for money—allocations, procurement, contracting, logistics, incentives, demand creation
Strengthening the prevention cascade
Delivery Support

Optimizing geographic prioritization and the treatment cascade in Bangkok, Thailand

The four districts with concentrated MSM activities (hotspots) in metropolitan Bangkok

The most economic site-specific expansion pathway

Provision of ART services

- Status quo
- Universal ART in 3 years
- Universal ART in 5 years
- Universal ART in 10 years

Utilize private hospitals

Extra annual spending (US$ millions)

Extra ART person-years required annually ('000, in 2022)

Provision of HIV testing services

- Status quo
- Universal ART in 3 years
- Universal ART in 5 years
- Universal ART in 10 years

Utilize public facilities

Utilize BMA clinics

Utilize Research clinics

Utilize private hospitals

Extra HIV test required annually ('000, in 2022)
Bangkok has approximately 185,000 MSM. One-third are at high-risk. Only 14,000 were tested, and 4,000 tested positive. Less than 1,000 started treatment.

There are over 90 testing and treatment medical facilities in Bangkok that provide free and confidential HIV testing and treatment services. However, most are not used. Over 75% of HIV testing and treatment is done in only 2 clinics.

Currently, about 200,000 HIV tests are performed per year. Medical facilities have the capacity to provide an additional 400,000 HIV tests per year.

What can be done?

Create Demand
Create demand for testing and treatment services.
Create and stimulate demand for use of HIV testing and treatment services by MSM. Health facilities and MSM communities can join forces in this demand creation and stimulation.

Invest
Invest in early testing and treatment. It will not only save lives. It will also cut costs.
An additional $55 million investment will increase HIV treatment coverage to 80%. Over 5,000 HIV-related deaths and 3,700 new cases can be prevented each year. It costs only $10,000 to save one life from HIV-related deaths.

Scale Up
Scale up testing and treatment at public medical facilities.
Public hospitals can test and treat patients effectively and at the lowest cost.

Sources: Scaling up HIV Services for MSM: What Does It Take? Kirby Institute, University of New South Wales; Thai Red Cross Society AIDS Research Center; World Bank Group
Strengthening the circumcision cascade in Swaziland

- Knowledge on HIV risk reduction of MC (FLAS 2006)
- Knows where to get MC services (TRAC 2010)
- Men exposed to MC campaign (TRAC 2010)
- Men exposed to IPC (TRAC 2010)
- Intends to get circumcised in the future (TRAC 2010)
- Men who prefer their sons to be circumcised (MICS)
- Proportion of newborns circumcised
- Intends to get circumcised in the next 12 months (TRAC 2010)
- Proportion of men circumcised during 12 months (TRAC 2011)
- Proportion of 2015 MC target reached by 2012
- Not circumcised because of fear/pain (MICS)
- Not circumcised because of religion/tradition (MICS)

Translating high intention into higher uptake:
Bring MC to men (schools, leave entitlement for MC), men’s health campaigns

Barriers: Pain
Response: Choice for devices causing less pain

Limitation: Varying sources with differing denominators
Treatment cascade to viral suppression, South Africa

- Rapid management analysis and “best” estimate in 3 months
- Intermediate “big data” analysis with proximate indicators in 1 year
- Rigorous prospective evaluation in 2 years
Delivery Support

South Africa Big Data work

VL and CD4 data are underused for decision-making in SA.

With >3 million ART patients, targeting of ART adherence efforts must be guided by data.

Linking databases from National Health Laboratory and National Health System through complex matching procedure and newly developed algorithm.

44 million lab results matched to 12.68 million new, unique patient IDs.

Provides spatial and demographic pattern of viral suppression levels.

Mitigates lack of working unique patient identifier in South Africa.
Results on viral suppression

75% had received at least one VL test in the 12 months HIS only reports half of these. Of these, 78% clients virologically suppressed, but:

- 1 in 5 not suppressed
- 1 in 3 of the under 25s not suppressed
- 1 in 8 had VL > 10,000 (high risk of transmission)
- 1 in 6 male patients > 10,000

Best performing districts had 30% higher VLS than worst performing districts.

Facilities and districts with higher ART patient numbers do better on VLS.

200 clinics with VLS below 50%
3.6% of clinics reach VLS of 90% or more
Exploring viral suppression data

Identifying Successes
Proportion of ART clients with known VL suppression (<400 cp/ml)

Proportion viral load suppression

- <40%
- 41%–50%
- 51%–60%
- 61%–70%
- ≥71%

Can we learn from the dark-shaded sub-districts?

Identifying Failure
Number of ART clients with high VL (>1,000 cp/ml)

Number of clients

- 0–360
- 361–750
- 751–1350
- 1351–2350
- 2351–28,000

Low hanging fruit for better adherence support
Results on immune recovery

900K CD4 tests included of persons with estimated ART initiation in 2010–14 and evidence of VLS

- 47% with baseline CD4 <200
- 70% tests are from females
- Males start ART later at median CD4 177 (females at 228)

Time to immune recovery:
- longer among males, to 200, 350 and 500
- increased with higher age of patient
- decreased with the calendar year of ART initiation
The third 90 is possible—**132 ART sites** have viral suppression of 90% or higher—*Learning from success*

Failing clinics need extra VLS support—*most efficiently targeted to larger sites for impact, but smaller sites do fare worst*

Older males and those with <200 CD4 count at initiation need to be prioritized for continued CD4 count monitoring

**Strengthen prophylaxis for opportunistic infections** until immunological recovery occurs, to reduce AIDS-related morbidity/mortality

**Secondary analysis of large sets of routine data and novel approaches in record linkage** (sometimes referred to as big data) can contribute to **better targeting and more efficient implementation** of the South African ART program
Principles

- Pragmatic, nimble design
- Adept counterfactuals
- Proven proximate precursors
- Built into and builds onto what’s useful to clients

- Bosnia Herzegovina HSS—proposed
- Mauritania PBF—proposed
- Nigeria RMNCH—proposed
- Cameroon cash transfers, education and sexual and reproductive health—proposed with PD GSA
- Malawi demand creation—underway
- Zimbabwe service integration—underway with HS GSA
- South Africa HIV viral suppression big data evaluation—underway with HS GSA
- Swaziland cash transfers, education and sexual and reproductive health—underway with HS and PD GSA
- Indonesia HSS—proposed with DS GSA
- Cambodia HSS—proposed

Decision and Delivery Science

Evaluation Support
Next Steps: Pathways to more and better delivery

- Increase allocative efficiency (still lowest-hanging fruit)
- Reduce management costs (service squeeze)
- Improve procurement of supplies and services
- Strengthen contracting, including performance management and incentives
- Innovate, integrate, decentralize and simplify services—maximize simplicity of services and role of community health workers
- Emphasize demand creation, especially in lower volume facilities

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