Decision rules for allocation of finances to Health Systems Strengthening

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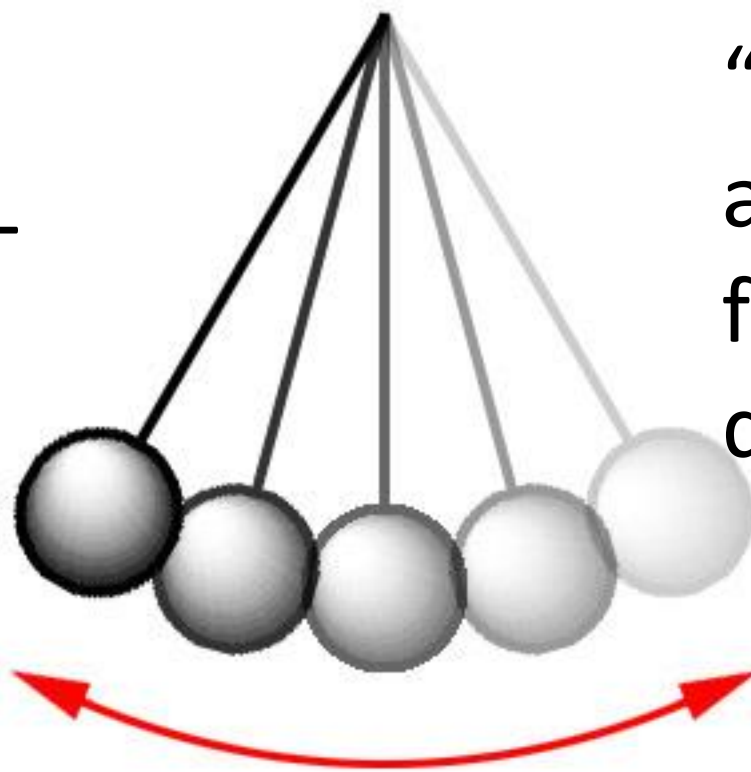
In historical context

“Horizontal” approaches – focus on the system



“Vertical” approaches – focus on the diseases

What is the “health system”?

- Service delivery: packages; delivery models; infrastructure; management; safety and quality; demand for care
- Health workforce: national workforce policies and investment plans; advocacy; norms, standards and data
- Information: facility and population based information and surveillance systems; global standards, tools
- Medical products, vaccines and technologies: norms, standards, policies; reliable procurement; equitable access; quality
- Financing: national health financing policies; tools and data on health expenditures; costing
- Leadership and governance: health sector policies; harmonization and alignment; oversight and regulation

WHO (2007) “Strengthening health system to improve health outcomes”

“The level of understanding, the sophistication of the evidence, the strength of the measures, and the credibility of strategies and interventions to strengthen health systems remain at a very primitive state and it's frustrating that we're not advancing more quickly on these fronts...’’

Hafner and Schiffman (2013), quoting a "senior WHO official with long-standing involvement in health systems research"

How do cost-effectiveness analysis for HSS interventions?

- HSS interventions are **complementary** with vertical programmes
  - Better trained staff can deliver treatments at higher levels of quality
  - Improved public health surveillance can allow for better targetting of interventions
  - Improved management can prevent loss and pilferage of commodities

Our model

Effect of strengthening cluster j

Benefits of investment in programme i in cluster j

$$\max \sum_{j \in J} w_j y_j^{\gamma} \sum_{i \in I(j)} v_{i,j} x_{i,j}$$

$$\text{s.t.} \sum_{j \in J} y_j + \sum_{j \in J} \sum_{i \in I(j)} c_{i,j} x_{i,j} \le B$$

$$p_j \le y_j \le P_j$$

$$0 \le x_{i,j} \le 1$$

Investment in strengthening the health system in cluster j (e.g. malaria)

Investment in programme i in cluster j (e.g. insecticide treated bednets)

Qualitative results

- This programme is
  - Non-linear
  - Non-convex
- But for each cluster, at optimality
  - There is a “critical project”
  - Everything funded in that cluster has ICER better than the ICER of the critical project
  - Everything not funded in that cluster has ICER worse than the ICER of the critical project

Algorithmic results

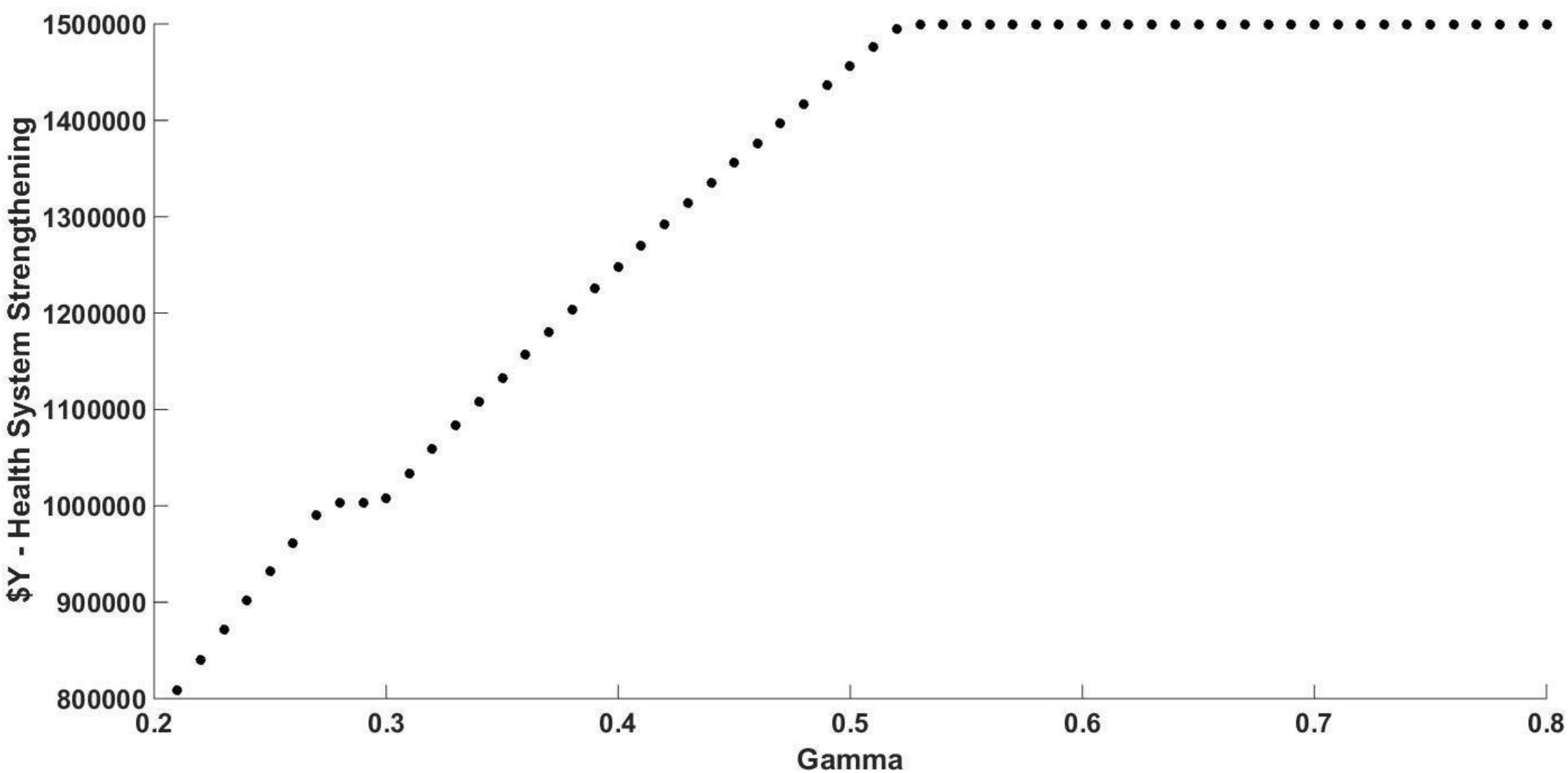
- When there is only one cluster…
  - Eg we are trading off between strengthening the malaria system vs bednets, spraying etc
- … the problem can be solved by hand
  - Check out "whole number allocations" where all projects are funded or not
  - Check out "fractional allocations" where there is a single critical project and all other projects are funded or not
- This is *O(n)* complexity where n is the number of projects

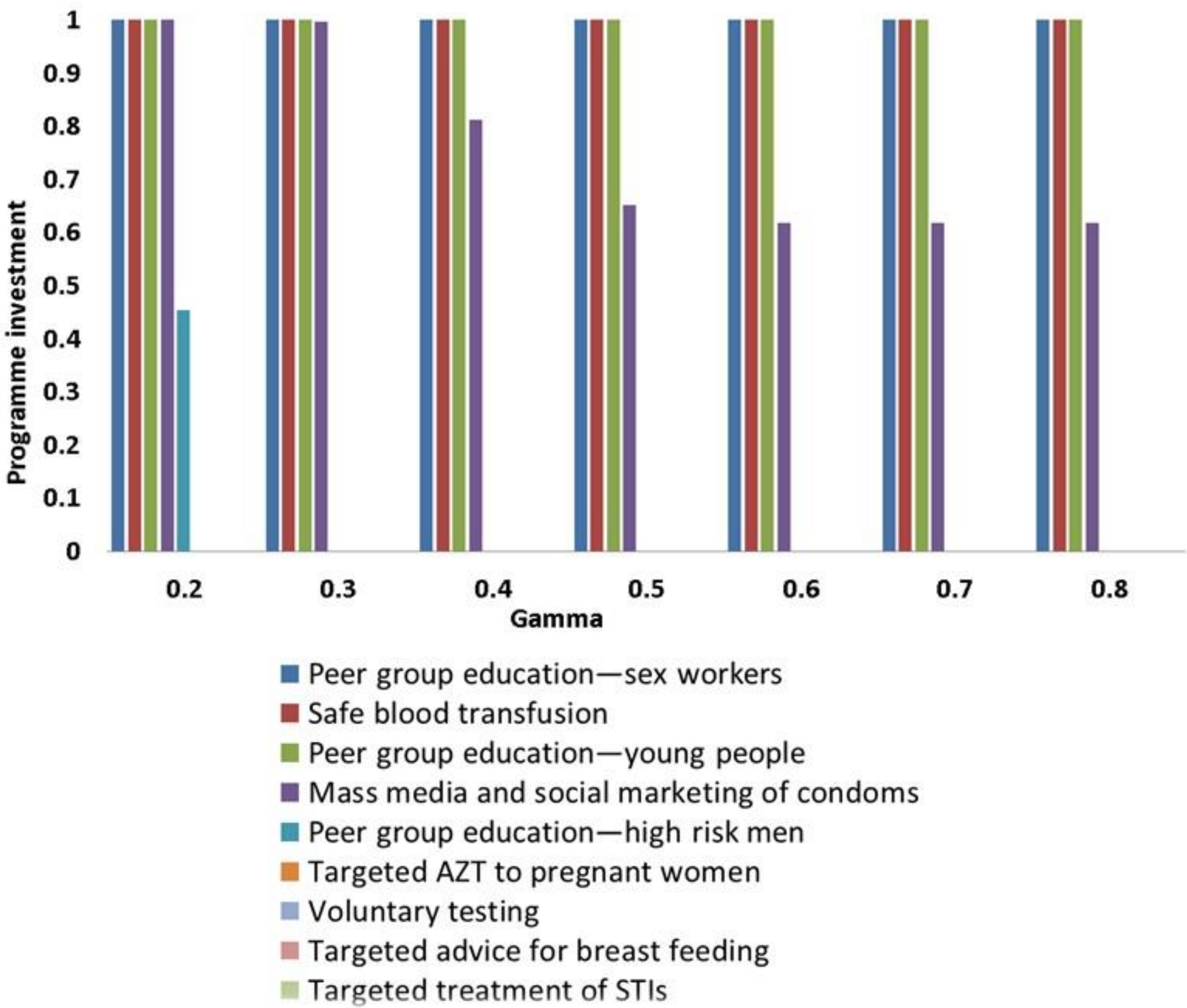
Worked example with one cluster

Table 1: Data for HIV prevention programmes

Intervention	Cost per HIV infection averted (US$2002)	Total Cost (US$)	Number of infections averted	Ratio of benefits to costs (cost-effectiveness)
	1	2	3	4
Peer group educationsex workers	16	39,575	2473	0.0625
Safe blood transfusion	84	50,000	595	0.0119
Peer group educationy-oung people	530	423,500	799	0.00189
Mass media and social marketing of condoms	534	1,300,000	2434	0.00187
Peer group educationhigh risk men	580	500,000	862	0.0017
Targeted AZT to pregnant women	939	300,000	319	0.0011
Voluntary testing	1190	310,000	261	0.0008
Targeted advice for breast feeding	2424	150,000	62	0.00041
Targeted treatment of STIs	2748	560,000	204	0.00036

HSS investment as gamma varies



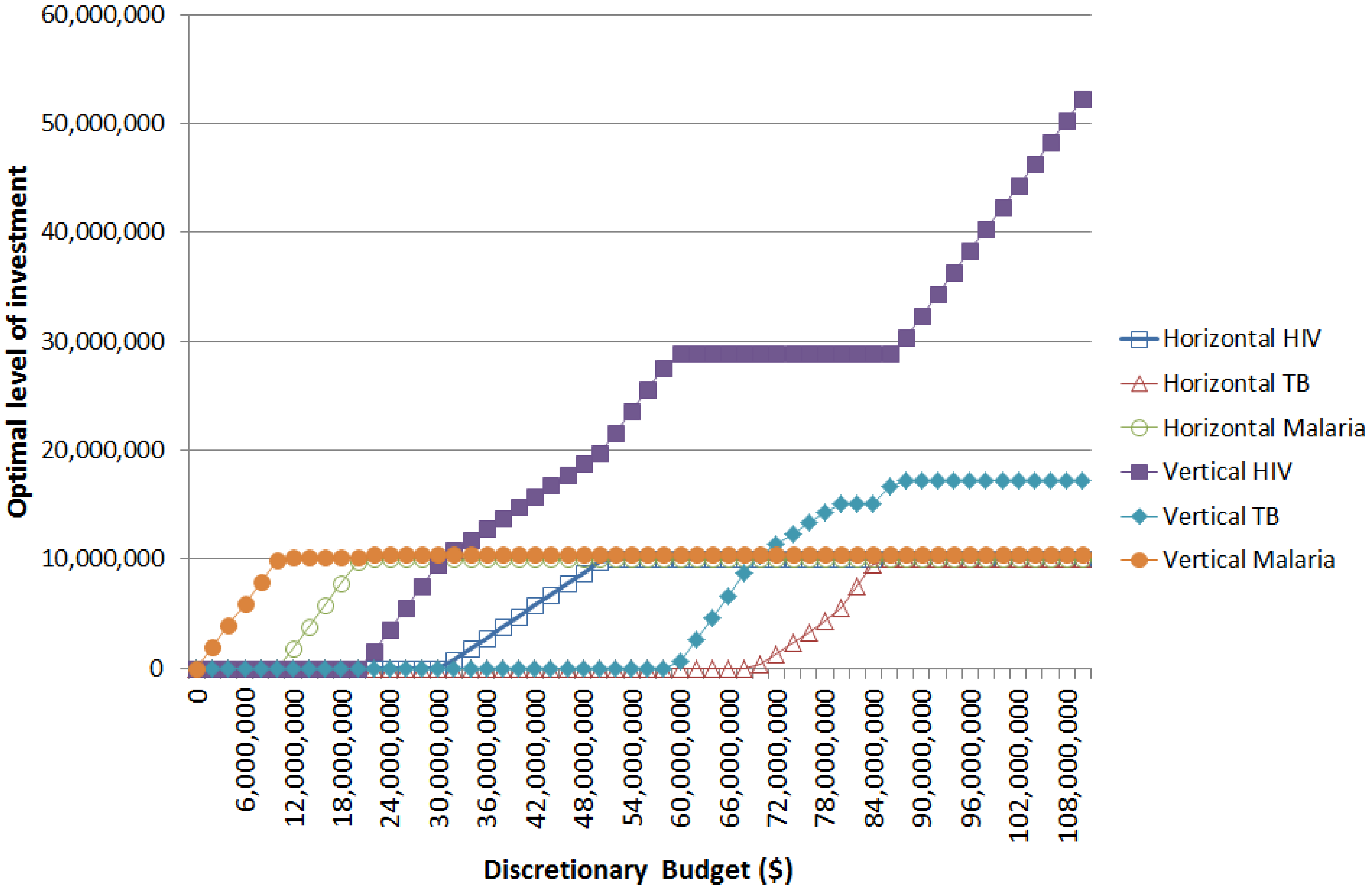

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Programme investment
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Gamma
Peer group education—sex workers
Safe blood transfusion
Peer group education—young people
Mass media and social marketing of condoms
Peer group education—high risk men
Targeted AZT to pregnant women
Voluntary testing
Targeted advice for breast feeding
Targeted treatment of STIs

Worked example with 3 clusters*

Table 4: Data for HIV, TB and Malaria example

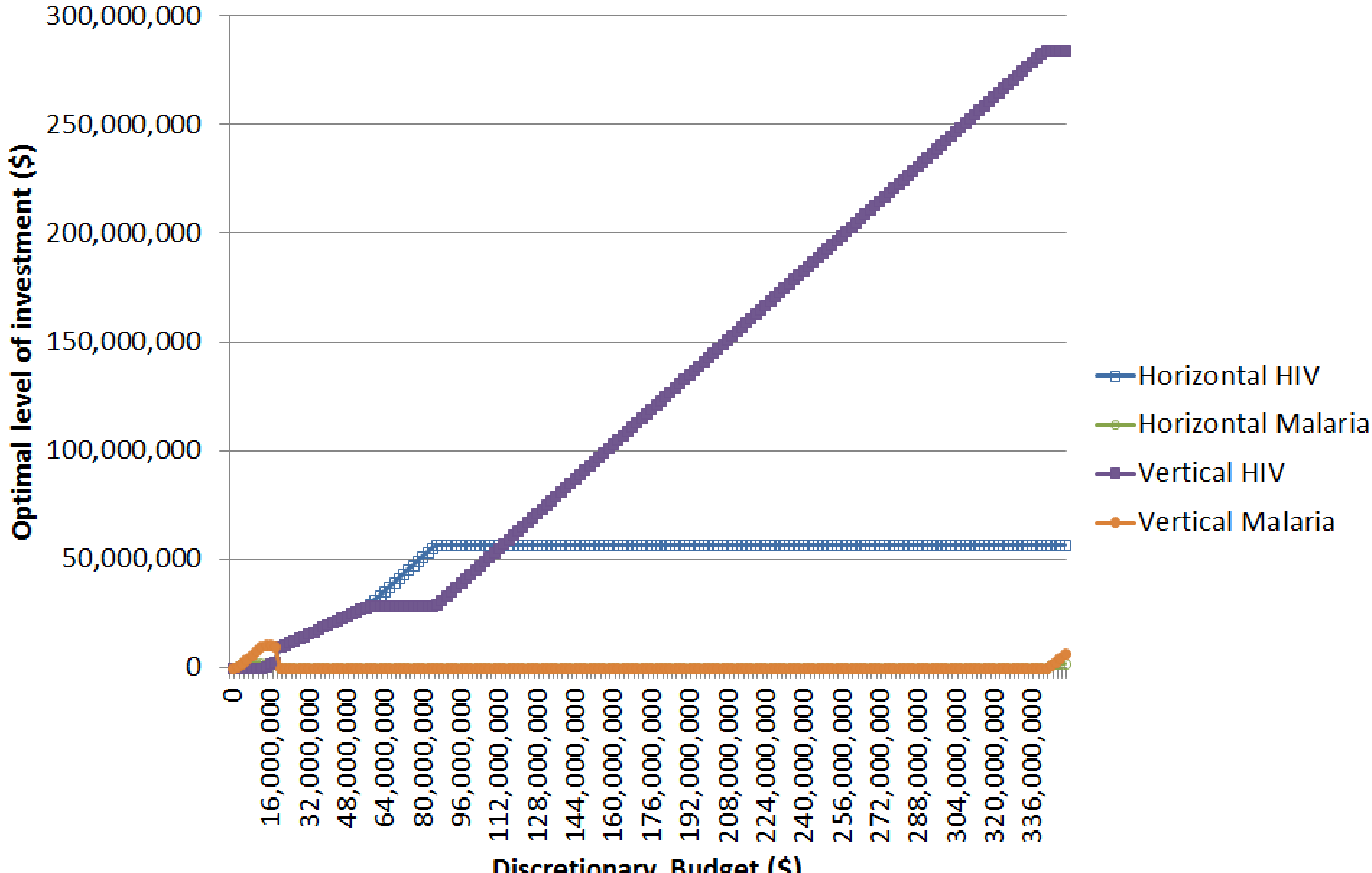
Intervention	Target population	Unit Cost of intervention (US$)	Total Cost (US$)	$ per DALY	Adherence	DALYS averted	Ratio of benefits to costs (cost-effectiveness)
	1	2	3	4	5	6	7
HIV							
Testing	1,700,000	17	28,900,000	38.27	0.39	294,512.67	0.0102
ART first line treatment	500,000	511	255,500,000	451.50	0.80	452,713.18	0.0018
TB							
DOTS treatment	20,000	755	15,100,000	132.96	0.95	107,889.59	0.0071
Diagnosis	140,000	9.98	1,397,200	126.35	0.34	3,759.78	0.0027
MDR-TB treatment	100	7,595	759,500	521.96	0.80	1,164.07	0.0015
Malaria							
Treatment with ACTs	5,000,000	2.03	10,150,000	13.91	0.60	437,814.52	0.0431
Intermittent preventive treatment in pregnancy (IPTp)	945,000	0.30	283,500	25.68	0.40	4,415.89	0.0156

* Solved computationally in Matlab



Optimal level of investment
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
0
6,000,000
12,000,000
18,000,000
24,000,000
30,000,000
36,000,000
42,000,000
48,000,000
54,000,000
60,000,000
66,000,000
72,000,000
78,000,000
84,000,000
90,000,000
96,000,000
102,000,000
108,000,000
Discretionary Budget ($)
Horizontal HIV
Horizontal TB
Horizontal Malaria
Vertical HIV
Vertical TB
Vertical Malaria

Nonconvexities can give counterintuitive results



Is this the right decision rule for donors?*

- Donor which can supply $1m to country to prevent HIV infections
- Country considers that spending more than $300 of its domestic resources to avert a single HIV infection is not good value for money

* Joint work with Ashwin Arulselvan

- Donor proceeds down the list in CE order
- **$1,000,000** will be spent on HIV prevention and **4,779** infections will be averted

	Total Cost $	Number infections averted	Cost per HIV infection prevented (US$, 2002)
1. Peer group education—sex workers	39,575	2473	16
2. Safe blood transfusion	50,000	595	84
3. Peer group education—young people	423,500	799	530
4. Mass media and social marketing of condoms ****	1,300,000	2434	534
5. Peer group education—high risk men	500,000	862	580
6. Targeted AZT to pregnant women	300,000	319	939
7. Voluntary testing	310,000	261	1190
8. Targeted advice for breast feeding	150,000	62	2424
9. Targeted treatment of STIs	560,000	204	2748

- Suppose subsidise interventions to make them CE for Country?
- Country spends its own funds on interventions 1 and 2

	Original Total Cost $	Number infections averted	Donor contribution $	Subsidised cost	Donor $/ infection averted
3.Peer group education—young people	423,500	799	183,800	239,700	230
4. Mass media and social marketing of condoms	1,300,000	2434	569,800	730,200	234
5. Peer group education—high risk men	500,000	862	241,400	258,600	280
6. Targeted AZT to pregnant women	300,000	319	204,300	95,700	640
7. Voluntary testing	310,000	261	231,700	78,300	888
8. Targeted advice for breast feeding	150,000	62	131,400	18,600	2119
9. Targeted treatment of STIs	560,000	204	498,800	61,200	2445

The total amount of investment by both D and C is therefore **$2,313,075** and the total number of infections averted is **7,163**.

Conclusion

- Assessing the influence of investment in HSS on vertical programmes seems the only way to do economic analysis
  - Finding empirical data to estimate function is a challenge
- Dynamics of investment in HSS can be counterintuitive
  - Individual items may enter and leave optimal portfolio as budget increases
- Maybe decision rules for donors aren’t the same as decision rules for countries

Thank you