



Economic Analyses of MGIT in Brazil, Zambia, and South Africa

Funded by CREATE and FIND, Bill and Melinda Gates Foundation

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FIND-BD Symposium
Cape Town



MISSION: reduce death and disease from TB in populations with high rates of HIV AIDS

APPROACH: implementation of research studies to assess impact of public health strategies for controlling the AIDS TB epidemic

- **THRio**

- Phased implementation study to determine whether routine detection and treatment of latent TB infection in patients served by HIV clinics in Rio de Janeiro reduces TB incidence in that population

- **Thibela TB**

- Cluster randomized trial to measure impact of community-wide IPT on TB prevalence at the community level in a population with high HIV prevalence

- **ZAMSTAR**

- Community randomized trial testing 2 interventions to reduce TB prevalence: improved TB case finding through increased access to TB diagnostics for those with symptoms, and household interventions centered on families with a TB case

3 Economic Analyses of MGIT

- **Brazil**
 - **Objective:** to inform Latin American TB programs with existing lab capacity on whether to use that capacity for TB culture
 - **Outcome measures:**
 - (a) cost/culture,
 - (b) cost/QALY,
 - (c) incremental cost/QALY
- **South Africa**
 - **Objective:** to inform policymakers on full costing and CEA comparing MGIT vs LJ, and MGIT+LJ vs LJ alone for smear (-) TB
 - **Outcome measures:**
 - (a) cost/additional TB case detected
 - (b) Cost/additional day to positive diagnosis
- **Zambia**
 - **Objective:** to inform national & int. policymakers on comparative CEA of MGIT vs. LJ
 - **Outcome measures:**
 - (a) cost/culture,
 - (b) cost/identified MTB,
 - (c) incremental cost/identified MTB on smear neg. only

Cost-Effectiveness and Impact of MGIT in THRio: Preliminary Results

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November 9, 2007
FIND Symposium

Brazil Study: Design

- Centralized lab serving large urban area
 - 19 clinics in RJ municipal region
 - Intervention: Training in clinic + LJ/MGIT availability
 - Specimens/results transported to lab/clinics
- Designed as incremental analysis
 - Assumes smear routinely performed
 - Existing lab capacity (but not staff or equipment) to implement MGIT

Lab Outcomes

Diagnosis	MGIT Result, n (%)			LJ Result, n(%)		
	Positive	Negative	Contam	Positive	Negative	Contam
Negative	0 (0)	100 (89)	12 (11)	0 (0)	101 (90)	11 (10)
<i>M. tuberculosis</i> :						
Smear-pos. (12)	12(100)	0 (0)	0 (0)	11 (92)	0	1 (8)
Smear-neg. (15)	10 (67)	3 (20)	2 (13)	10 (67)	4 (27)	1 (7)
Total TB (27)	22 (81)	3 (11)	2 (9)	21 (78)	4 (15)	2 (7)
Non-TB:						
<i>M. fortuitum</i> (6)	6 (100)	0 (0)	0 (0)	4 (67)	2 (33)	0 (0)
<i>M. avium</i> (5)	5 (100)	0 (0)	0 (0)	1 (20)	4 (80)	0 (0)
Other (4)	3 (75)	0 (0)	1 (25)	1 (25)	2 (50)	1 (25)
Total NTM (15)	14 (93)	0 (0)	1 (7)	6 (40)	8 (53)	1 (7)
Total (n = 154)	36 (23)	103 (67)	15 (10)	27 (18)	113 (73)	14 (9)
Time to Treatment	44 days			57 days		

Cost per Culture

Item/Category	8 patients/week		24 patients/week	
	LJ	MGIT	LJ	MGIT
Transportation (including driver)	\$8.66	\$8.66	\$2.89	\$2.89
Culture tubes/media	\$0.59	\$5.26	\$0.59	\$5.26
Personnel	\$3.79	\$3.79	\$1.26	\$1.26
MGIT reader	\$0.00	\$2.37	\$0.00	\$0.79
Mycoprep	\$2.09	\$2.09	\$2.09	\$2.09
Lab supplies (e.g., pipets, Falcon tubes)	\$1.59	\$1.54	\$0.88	\$0.87
Cryovials for specimen storage	\$0.81	\$0.81	\$0.81	\$0.81
Lab equipment (e.g., incubator, freezer)	\$0.53	\$0.40	\$0.18	\$0.13
Total cost per Negative Culture	\$18.06	\$24.93	\$8.70	\$14.10
Confirmation/speciation	\$21.43	\$21.43	\$12.07	\$12.07
Total cost per Positive Culture	\$39.49	\$46.36	\$20.77	\$26.17

Preliminary Cost-Effectiveness

Scenario	Cost (x1,000)	QALYs Gained	Incr. Cost (x1,000)	Incr. QALYs	ICER (\$/QALY)
<i>Throughput: 8 Patients/Week</i>					
Baseline	\$97 (\$68, \$131)	0 (ref)	\$0 (ref)	0 (ref)	0 (ref)
LJ	\$146 (\$108, \$198)	26.9 (9.1, 53.9)	\$49 (\$30, \$88)	26.9 (9.1, 53.9)	\$1789 (\$796,\$7148)
MGIT	\$177 (\$122, \$273)	30.4 (5.4, 62.8)	\$31 (-\$24, \$122)	3.5 (-14.8, 38.9)	\$8887
<i>Throughput: 24 Patients/Week</i>					
Baseline	\$97 (\$68, \$131)	0 (ref)	\$0 (ref)	0 (ref)	0 (ref)
LJ	\$129 (\$93, \$178)	26.9 (9.1, 53.9)	\$32 (\$18, \$68)	26.9 (9.1, 53.9)	\$1212 (\$474,\$5181)
MGIT	\$156 (\$103, \$250)	30.4 (5.4, 62.8)	\$27 (-\$27, \$114)	3.5 (-14.8, 38.9)	\$7631

Take-Home Messages from this Preliminary Analysis

- TB Culture (LJ and MGIT) can be cost-effective.
 - High patient volume is important.
- Drivers of cost
 - Transportation (low volume)
 - BBL tubes (high volume)
- NTM rates were unexpectedly high.
 - 39% of all positive MGIT results



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Cost-effectiveness of LJ vs MGIT: data from the Thibela TB study

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OBJECTIVE

- The study is a full cost effectiveness analysis comparing
 - ✓ 1) MGIT vs. LJ to
 - ✓ 2) MGIT AND LJ vs. LJin the detection of smear negative TB

METHOD I

TB suspects identified by:

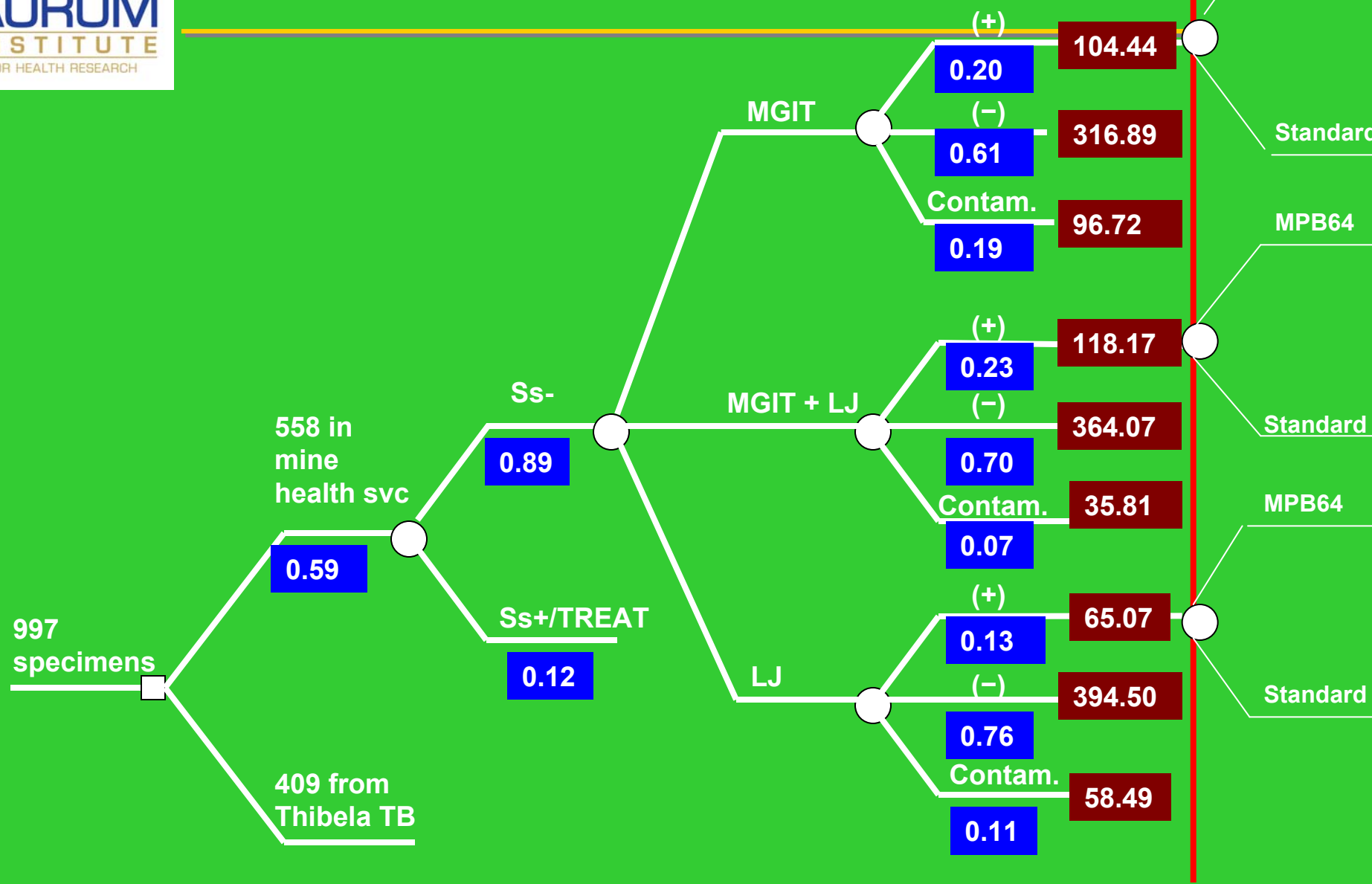
- Thibela TB study (a cluster-randomized trial of community-wide isoniazid preventive therapy in South African gold mines)
 - screening prior to IPT
 - at follow-up during IPT
- Routine mine health services across three gold mining companies participating in Thibela TB

METHOD II

- **Outcome Measures:**
 - Cost per additional case detected MGIT versus LJ
 - Cost per additional day of correct positive diagnosis MGIT versus LJ
- *Cost effectiveness would usually utilise final health outcomes I.e. follow up to treatment outcomes modelled to life years gained (outside scope of study)*

- **Costing**
 - Full economic costing from a health service perspective (private sector and public sector)
 - Resource utilisation collected at both site and central laboratory level valued at 2007 prices (adjusted where necessary)
 - Average cost per test calculated as weighted site cost (proportionate contribution to study sample) plus laboratory cost per test

Intermediate Effectiveness Model



Effectiveness Results (smear neg only)

- **Additional positive cases detected**
 - MGIT vs LJ = 66 cases
 - MGIT + LJ vs LJ = 89 cases
- **Additional days positive diagnosis** (Base case: positive on both cultures, n = 87)
 - MGIT vs LJ = 1044 days



LJ SITE & LABORATORY COSTS

(All costs in SAR)

Site Costs	10 month cost	Tests	Cost per test
<i>Capital Costs</i>	41,702.45	689	60.53
<i>Recurrent Costs</i>	90,051.38	689	130.71
SUB TOTAL	131,753.83		191.22

Laboratory Costs	10 month cost	Tests	Cost per test
<i>Capital Costs</i>	2,932.95	997	2.94
<i>Recurrent Costs</i>	67,095.12	997	67.29
SUB TOTAL	70,028.08		70.24

TOTAL COSTS	201,781.90		261.46
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MGIT SITE & LABORATORY COSTS

(All costs in SAR)

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Site Costs	10 month cost	Tests	Cost per test
<i>Capital Costs</i>	41,702.45	689	60.53
<i>Recurrent Costs</i>	90,051.38	689	130.71
SUB TOTAL	131,753.83		191.22

Laboratory Costs	10 month cost	Tests	Cost per test
<i>Capital Costs</i>	63,317.96	997	63.51
<i>Recurrent Costs</i>	143,259.86	997	143.69
SUB TOTAL	206,577.82		207.20

TOTAL COSTS	338,331.65		398.42
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Cost Results I

(all costs represented in Apr 2007 US dollars)

- **Average cost per MGIT conducted**
 - \$56.92
- **Average cost per LJ conducted**
 - \$37.35
- **Average cost per MGIT / LJ conducted**
 - \$57.13 per patient specimen

Cost Effectiveness Results II

- **Cost per additional case detected**
 - MGIT vs LJ = \$293.67
 - MGIT + LJ vs LJ = \$220.26
- **Cost per additional day positive diagnosis** (for those positive on both tests)
 - MGIT vs LJ = \$1.63

CONCLUSION

- Note MGIT plus LJ is more cost effective than MGIT alone.
- Note that the higher cost effectiveness of doing both cultures is because this increases the chance of having a result which is not contaminated.
- It may be that doing two MGITs is even more cost effective than MGIT plus LJ and this could be further investigated.
- *(Updated laboratory data for this study can be seen on poster PS-71729-10 on Saturday morning)*

*Cost-Effectiveness of TB Cultures
using conventional LJ media versus
MGIT liquid media techniques*

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Aim of this Study

- To establish the **cost and cost-effectiveness per identified MTB culture** using various culture techniques in a developing country setting (Zambia):
 - LJ technique (with home-made LJ media)
 - LJ technique (commercial LJ media)
 - MGIT technique (manually read)
 - MGIT technique (automated MGIT 960)

Objectives and target audience

- To inform local and international policymakers on comparative economic costs and cost-effectiveness of applying various culture media
- To inform the management of the Zambian reference laboratory on disaggregated costs (efficiency)

Outcome measures

1. Cost per processed culture
2. Cost per identified MTB culture
(confirmed by subculture & Niacin test)
3. Incremental cost of performing culture on smear-negative samples only

Approach & Methods I

- **Economic costing**
 - Capital costs annualised and discounted at 3%
 - Inclusive of opportunity costs (incl. donations and salaries of gov't staff as well as externally paid staff)
- **Provider's perspective**
 - from collection of samples within Lusaka to the safe disposal of waste and posting of results. Cost include subculture and confirmation of MTB by Niacin test for all positive cultures. Costs do not include costs borne by patients.
- **Ingredients approach**
 - Itemised costing, based on expenditure reviews, quotations for consumables and equipment, observations of procedures and interviews with staff.

Approach & Methods II

- **Overheads**
 - Separately costed on site by itemised costing. Apportioned between different tasks according to workload (“step” approach).
- **“Step” approach**
 - As different tasks within CDL require different amounts of resources, an approach was used whereby the number of steps per procedure were counted and overhead and shared costs were divided by number of steps.
- **Cost related to yield of all four methods**
 - Different rates of MTB yield applied for each of the 4 methods in order to obtain cost per identified case.

Assumptions & Sensitivity Analysis

Parameter	Baseline	Sensitivity analysis
Prices for MGIT equipment & consumables	according to FIND negotiations for low-income countries	Market prices (Becton Dickenson)
Throughput	avg. for Jan.'05 – Jul.'06: 240/month	Double, maximum (acc. to MGIT equipm)
Confirmatory test	Niacin	Capilia, no confirmatory test
Exchange rate	avg. Jan.-Jun.'06: 1,000 ZMK = 0.32 USD	Jun.-Dec.'06: 1,000 ZMK = 0.27 USD
Discount rate	3%	5%
Yield	actual yield at Zambian lab.	modelled acc. to meta-analysis (Cruciani et al.)

Results: Cost of Homemade LJ

	US Dollar (USD)		
	per culture	per ident. MTB	%
Consumables	5.52	64.12	18.9
Equipment	4.61	53.47	15.7
Staff	1.44	16.73	4.9
Subtotal culture specific costs	11.57	134.33	39.5
<i>Running costs</i>	9.37	108.79	32.0
<i>General cleaning consumables</i>	0.11	1.25	0.4
<i>Stationary</i>	0.36	4.21	1.2
<i>Furniture</i>	0.31	3.54	1.0
<i>Equipment</i>	2.60	30.15	8.9
<i>Staff</i>	4.97	57.66	17.0
Subtotal overheads	17.71	205.60	60.5
Total	29.28	339.93	100.0

Results: Costs compared between 4 methods

	Homemade LJ		Commercial LJ		Manual MGIT		Automated MGIT	
	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>
Consumables	5.52	64.12	4.64	51.93	7.15	44.78	7.14	44.71
Equipment	4.61	53.47	4.12	46.11	4.05	25.34	5.48	34.29
Staff	1.44	16.73	1.31	14.73	1.73	10.85	1.24	7.79
Subtotal culture specific costs	11.57	134.33	10.07	112.77	12.94	80.97	13.86	86.78
<i>Running costs</i>	9.37	108.79	9.39	105.19	9.78	61.19	9.72	60.83
<i>General cleaning consumables</i>	0.11	1.25	0.11	1.21	0.11	0.70	0.11	0.70
<i>Stationary</i>	0.36	4.21	0.37	4.10	0.44	2.75	0.43	2.72
<i>Furniture</i>	0.31	3.54	0.31	3.43	0.32	1.99	0.32	1.98
<i>Equipment</i>	2.60	30.15	2.60	29.15	2.71	16.96	2.69	16.86
<i>Staff</i>	4.97	57.66	4.98	55.75	5.18	32.43	5.15	32.24
Subtotal overheads	17.71	205.60	17.75	198.81	18.53	116.02	18.42	115.32
Total	29.28	339.93	27.82	311.58	31.47	197.00	32.28	202.10

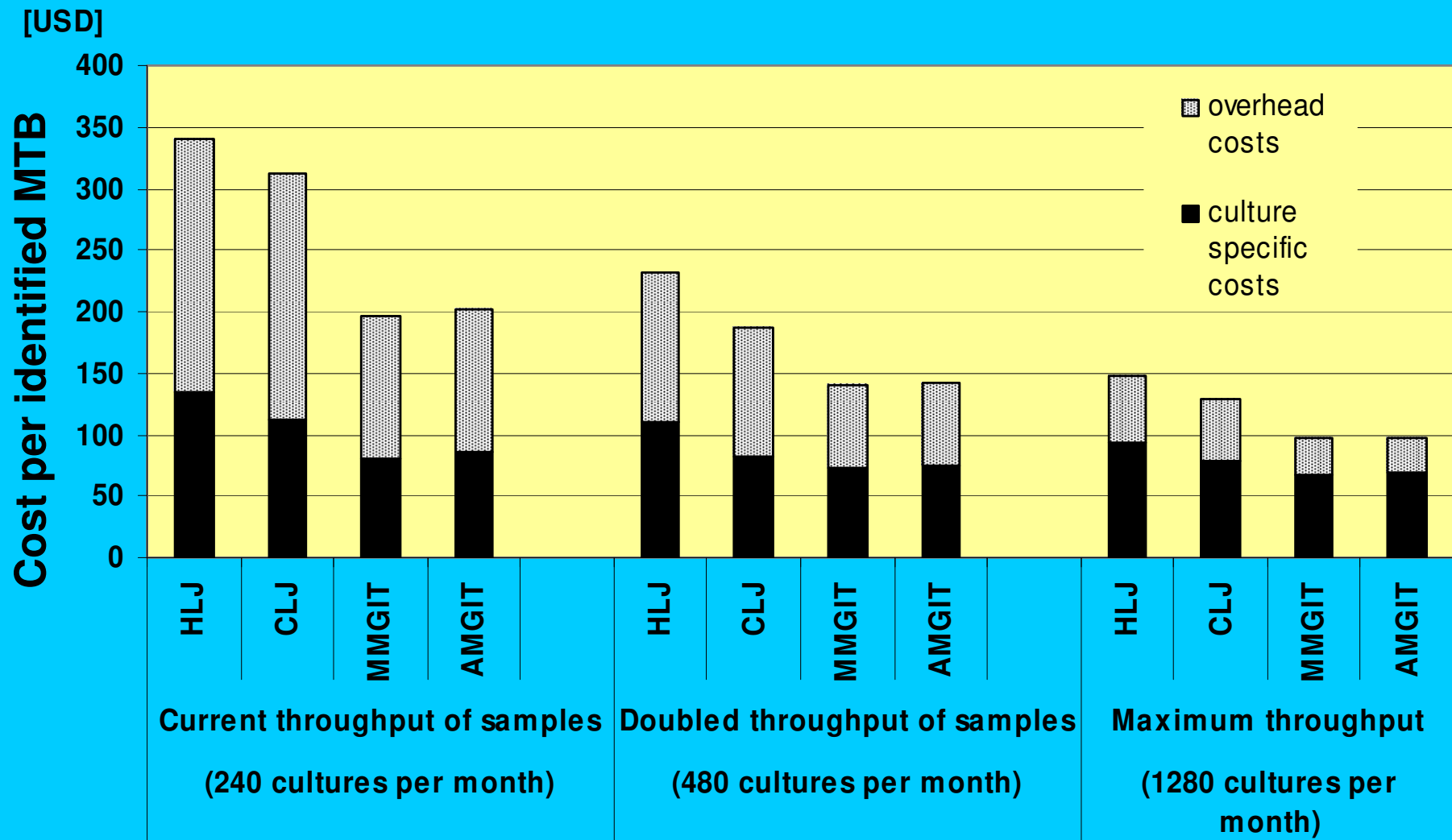
Results: Costs per identified MTB – smear negative specimen vs. smear negative & positive

US Dollar (USD)	Homemade LJ		Commercial LJ		Manual MGIT		Automated MGIT	
	smear pos. & neg	smear neg. only	smear pos. & neg	smear neg. only	smear pos. & neg	smear neg. only	smear pos. & neg	smear neg. only
Consumables	64.12	134.43	51.93	103.02	44.78	105.96	44.71	105.78
Equipment	53.47	113.74	46.11	92.94	25.34	60.54	34.29	82.70
Staff	16.73	35.08	14.73	29.21	10.85	25.68	7.79	18.42
Subtotal culture specific costs	134.33	283.25	112.77	225.17	80.97	192.17	86.78	206.90
<i>Running costs</i>	108.79	237.60	105.19	217.15	61.19	155.86	60.83	154.99
<i>General cleaning consumables</i>	1.25	2.73	1.21	2.49	0.70	1.79	0.70	1.78
<i>Stationary</i>	4.21	8.83	4.10	8.13	2.75	6.50	2.72	6.43
<i>Furniture</i>	3.54	7.74	3.43	7.07	1.99	5.08	1.98	5.05
<i>Equipment</i>	30.15	65.84	29.15	60.17	16.96	43.19	16.86	42.95
<i>Staff</i>	57.66	125.92	55.75	115.09	32.43	82.60	32.24	82.14
Subtotal overheads	205.60	448.66	198.81	410.11	116.02	295.02	115.32	293.34
Total	339.93	731.90	311.58	635.27	197.00	487.19	202.10	500.24

Results: Sensitivity Analysis, example: automated MGIT

	<i>Base case: Avg. no of culture betw. 1/2005 - 6/2006</i>		<i>No of cultures at maximum capacity</i>		<i>BD advertised prices instead of FIND agreed pricing</i>		<i>Exchange rate changed from Jan-Jun '06 to Jul-Aug'06</i>		<i>Capilia test instead of Niacin for confirmation</i>	
	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>	<i>per culture</i>	<i>per ident. MTB</i>
Consumables	7.14	44.71	7.14	44.70	10.31	64.56	7.12	44.56	6.20	38.82
Equipment	5.48	34.29	2.59	16.20	7.09	44.41	5.48	34.29	5.13	32.10
Staff	1.24	7.79	1.24	7.79	1.24	7.79	1.05	6.57	1.10	6.91
Subtotal culture specific costs	13.86	86.78	10.97	68.68	18.65	116.76	13.65	85.42	12.43	77.83
<i>Running costs</i>	9.72	60.83	2.30	14.38	9.72	60.83	8.37	52.39	9.72	60.83
<i>General cleaning consumables</i>	0.11	0.70	0.03	0.16	0.11	0.70	0.10	0.63	0.11	0.70
<i>Stationary</i>	0.43	2.72	0.43	2.72	0.43	2.72	0.37	2.29	0.43	2.72
<i>Furniture</i>	0.32	1.98	0.07	0.47	0.32	1.98	0.27	1.67	0.32	1.98
<i>Equipment</i>	2.69	16.86	0.64	3.98	2.69	16.86	2.43	15.21	2.69	16.86
<i>Staff</i>	5.15	32.24	1.22	7.62	5.15	32.24	4.35	27.20	5.15	32.24
Subtotal overheads	18.42	115.32	4.69	29.33	18.42	115.32	15.88	99.39	18.42	115.32
Total	32.28	202.10	15.66	98.01	37.07	232.07	29.52	184.81	30.85	193.15

Results: Sensitivity Analysis, Impact of Throughput



Conclusions

- Costs per culture are similar between the 4 techniques
- Due to higher yield, MGIT appears to be superior in cost-effectiveness terms (especially in Zambia)
- High impact of throughput of cultures performed at the laboratory
- Overheads form more than 50% of the cost of culture at current throughput!
- Overall high costs per identified MTB (> USD 190 at current throughput and > USD 90 at maximum throughput)
- Incremental cost per identified MTB substantially higher when culture would only be performed on smear-negative specimens (> USD 480 at current throughput, > USD 230 at maximum throughput)