

Cost-effectiveness of the Xpert MTB/RIF

Preliminary findings

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Objectives

Estimate the cost-effectiveness of the Xpert MTB/RIF system by decision-analytic simulation modeling

- comparing various diagnostic scenarios to current practice,
- evaluate them for a range of epidemiological and health service settings,
- health service perspective

Methods

■ Setting

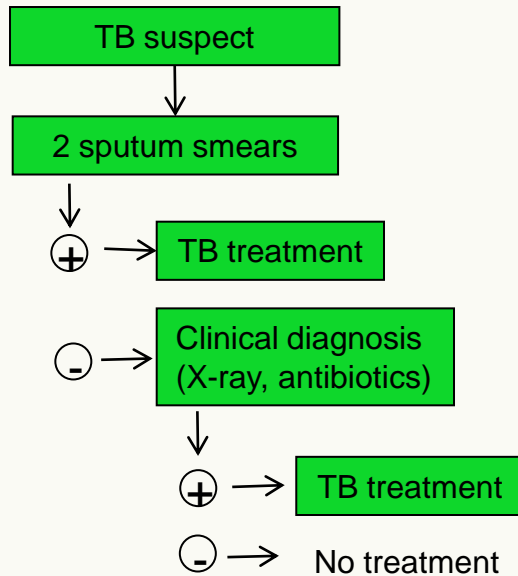
- low HIV prevalence, low MDR prevalence: India
- high HIV prevalence, low MDR prevalence: Uganda
- high HIV prevalence, high MDR prevalence: South Africa

■ Applying standard practices to local settings

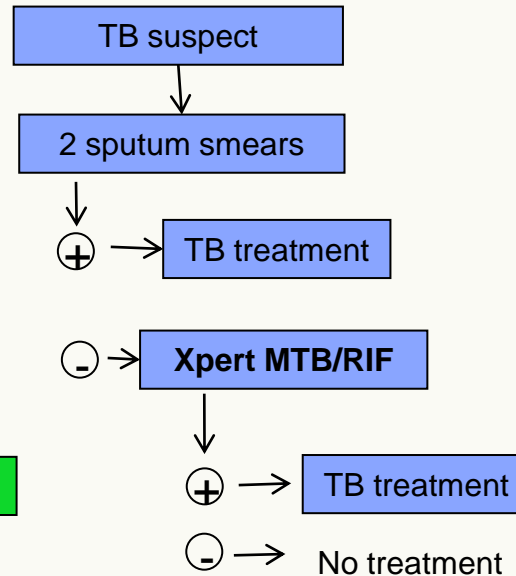
- Epidemiological conditions
- Estimated local health service and measured test costs
- Protocols
- Data on effectiveness from the FIND demonstration study (“field trial”) and literature
- Treatment outcomes from literature

Diagnostic scenarios

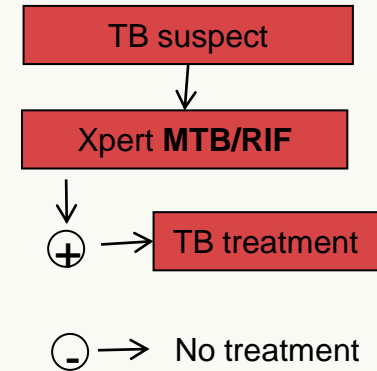
Current practice *Base case*



Xpert in addition to smear examination



Xpert instead of smear examination



+ Conventional DST of all diagnosed retreatment patients

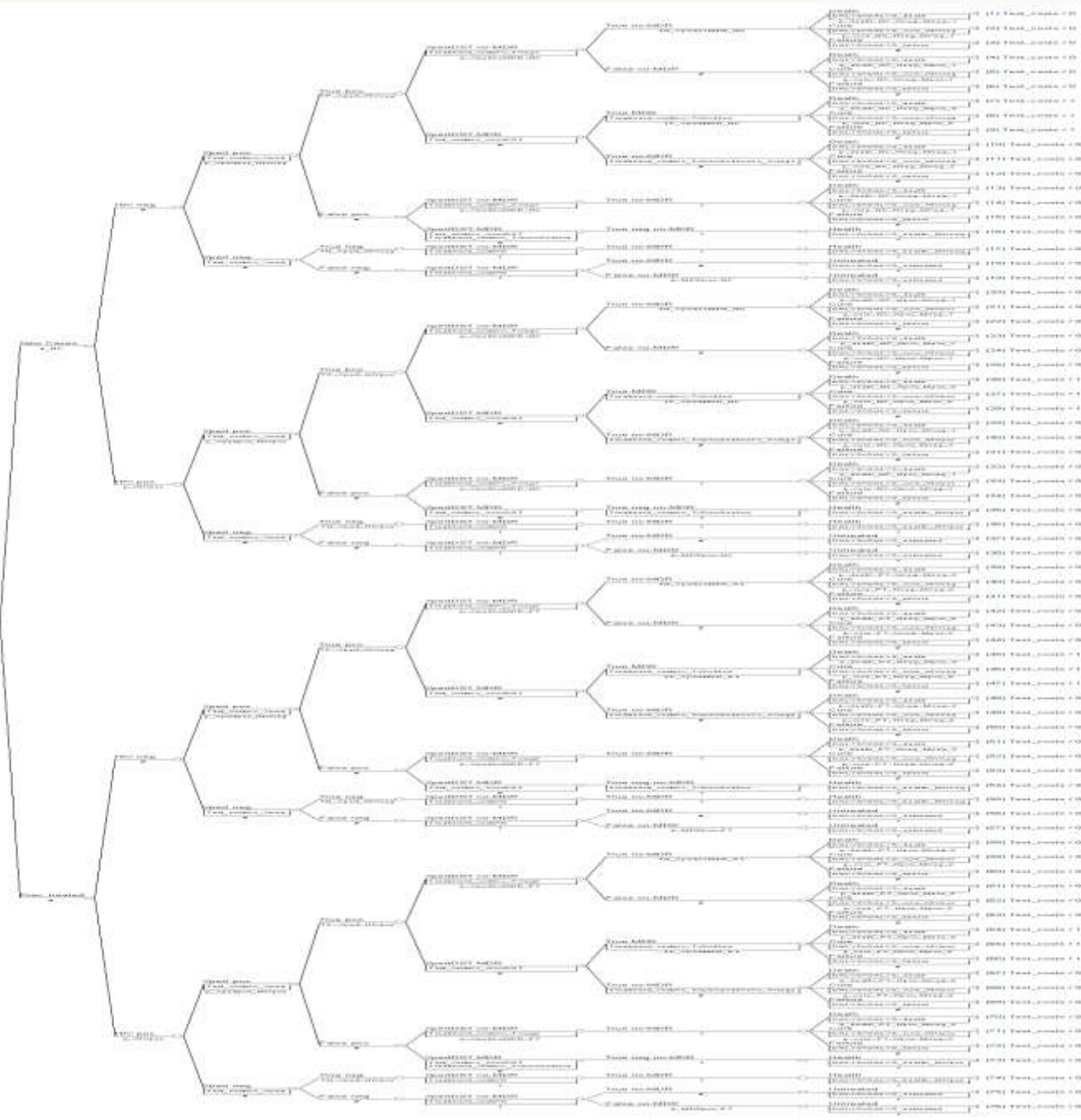
+ Xpert screening for all smear-positive retreatment patients

Model

- 10,000 *TB suspects* including patients with S+ and S- pulmonary TB
 - Presenting with prolonged cough with or without systemic or other symptoms suggestive of pulmonary TB – as in field trial
- Separately for:
 - new and previously treated patients
 - HIV- and HIV+ patients
 - RIF-resistance/MDR
- Apply costs for testing and treatment to each step
- Estimate numbers of patients, deaths averted and DALYs gained for each pathway

The Model

Node	Value
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99	0.000000
100	0.000000



TreeAge Pro Software
(Williamstown MA,
USA)

Cohort assumptions

	India	South Africa	Uganda	Source
% TB suspects	10%	10%	10%	
% previously treated	19.2%	16.8%	7.3%	WHO Global TB Report 2009 update
% MDR new patients	2.3% ¹	6.6% ^{1,2}	1.1% ³	¹ WHO 2010 DR Report ² Interpolation ³ Unpublished data
% MDR PrevTx patients	17.2% ¹	24.5% ^{1,2}	11.7% ³	¹ WHO 2010 DR Report ² Interpolation ³ Unpublished data
% HIV	0.63% ¹	24.8% ¹	31.9% ²	¹ WHO Global TB Report 2009 update ² Unpublished data
% S+ among HIV- patients	65%	65%	65%	Demonstration study
% S+ among HIV+ patients	47%	47%	47%	Demonstration study

Probability of HIV is independent of retreatment/ treatment status

Probability of RIF-resistance/MDR is independent of HIV status

Treatment assumptions

- Treatment follows diagnosis:
 - Patients are treated correctly following diagnosis
 - New patients are treated with 2HREZ/4HR
 - Retreatment patients with no RIF-resistance are treated with 2HRZES/1HRZE/5HRE
 - Patients with RIF-resistance/MDR are treated with the standard second-line treatment regimen currently used in PMDT (*Uganda = India*)
 - Patients can only have cure, failure and death as treatment outcomes
 - All HIV+ patients get HAART
- Xpert showing RIF resistance are started in second-line treatment, then followed by conventional DST
- Patients treatment awaiting conventional DST results are started on first-line treatment, and switched to second-line treatment if RIF-resistant/MDR

Other key assumptions

Follow-up

- Undiagnosed suspects with TB return after 3 months
- 10% of smear-negative TB patients will after 3 months be smear-positive

DALYs (*Disability Adjusted Life Years*)

- Disability weights GBD 2004
- All HIV+ patients get lifelong HAART
- Survival on HAART estimated using results of published Markov model (Cleary 2009)
- Untreated sm- patients probably of death (0.085) much lower than Sm+ (0.213). For HIV+ patients (0.5)
- Spontaneous recovery also included

The model does NOT take into account...

- Repeated treatment episodes
 - a patients who fails on treatment is assumed to remain untreated
 - Relapses
- Effects of diagnostic delay on treatment outcomes
- Transmission effects
- Patient costs

Costing

Diagnostic costs

- All costs measured through *direct observations*
 - Specific for each country
 - In different *routine* settings
- Ingredient costing approach
- Incremental costs includes all assay costs, labour, equipment and building space, all processes (facility based average costs).

Treatment costs

- Includes costs for drugs, clinic visits, follow-up tests, treatment supervision
- Based on WHO Choice estimates, published drug prices and literature

Results

Costing results diagnostics

Model predictions

Incremental cost-effectiveness ratios

Sensitivity analyses

Costing

Lab test	Setting	Costs per patient (US\$)		
		India	South Africa	Uganda
AFB Smear (one smear)	Peripheral lab	1.25	1.36	1.28
Xpert (current pricing)	Peripheral lab	25.15	33.65	28.36
Xpert (Vol. > 1.5 Mil / Yr)	Peripheral lab	21.15	29.65	24.33
Xpert (Vol. > 3.0 Mil / Yr)	Peripheral lab	17.25	25.76	20.36
Culture (LJ)	Reference lab	21.62		16.32
Culture (MGIT)	Reference lab		19.46	19.49
DST (LJ)	Reference lab	30.39		24.67
DST (MGIT)	Reference lab			45.69
Antibiotic trial	Routine clinic	3.66	9.70	2.41
Chest X-ray	Routine clinic	11.88	18.12	3.65

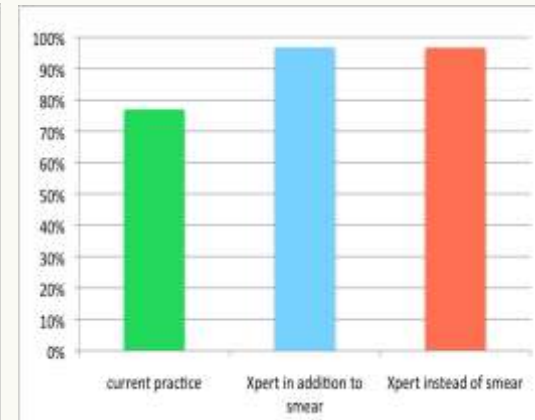
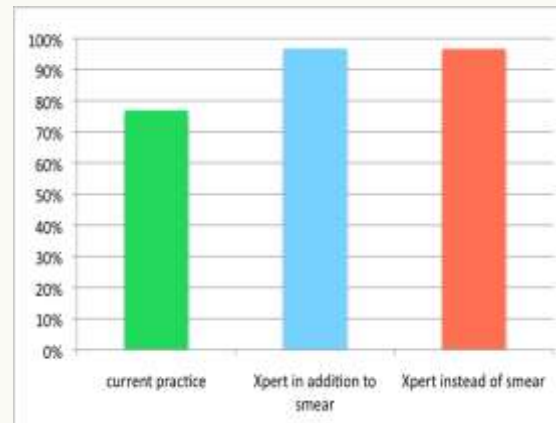
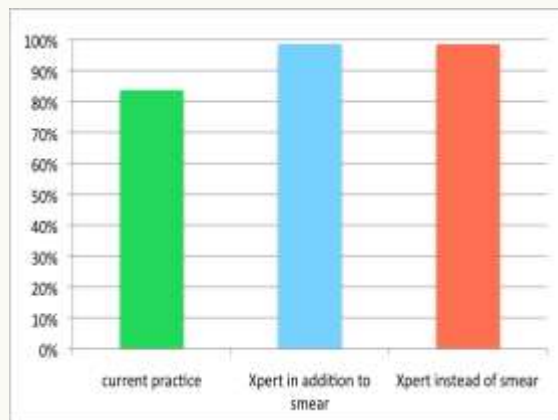
Model predictions: case detection

India

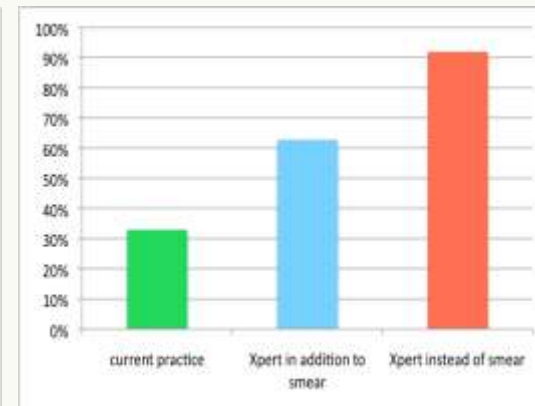
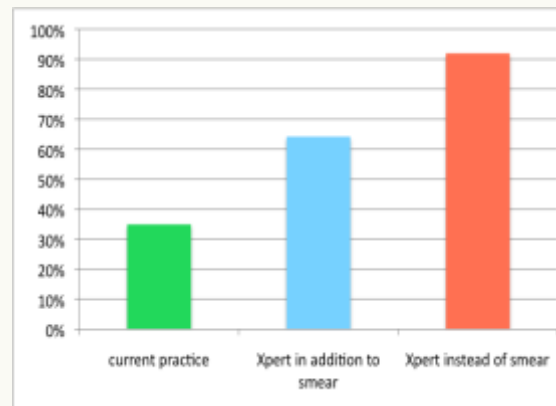
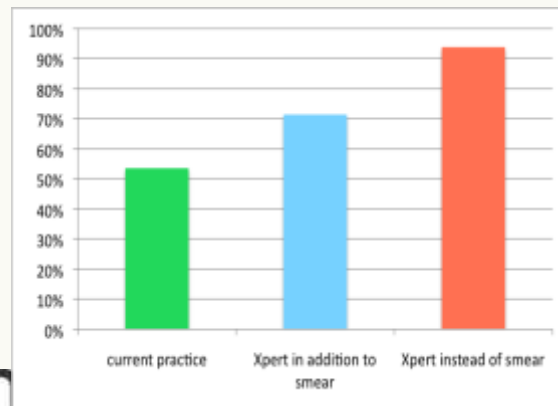
Uganda

South Africa

All TB



MDR TB



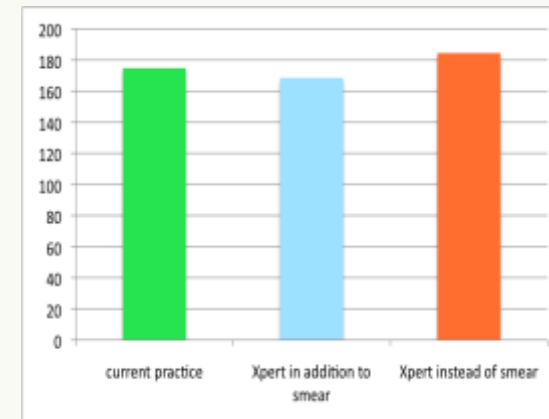
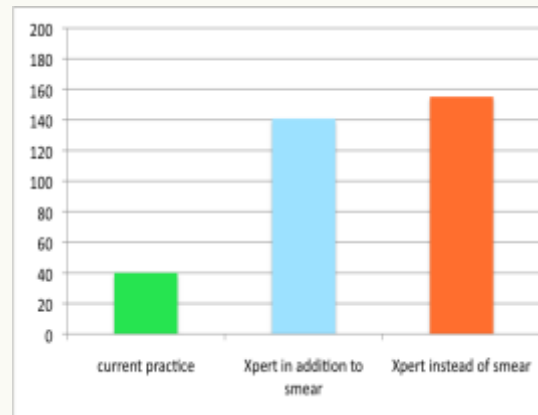
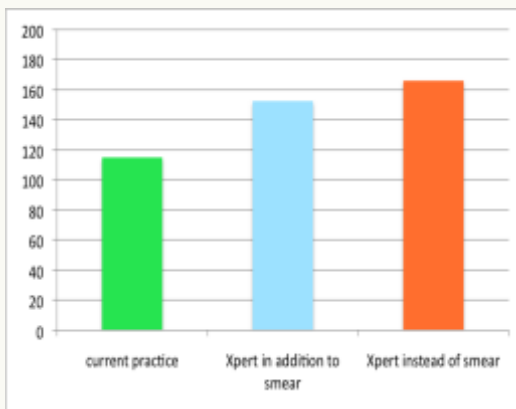
Diagnostic cost per TB case detected (US\$2010)

India

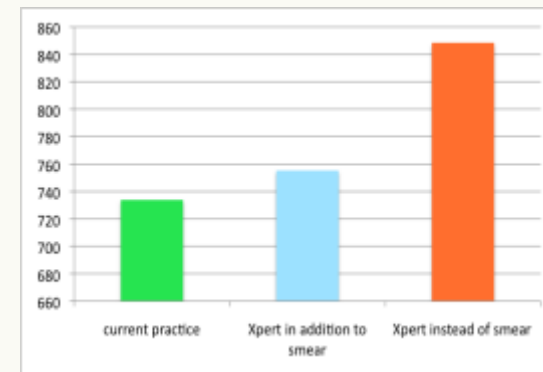
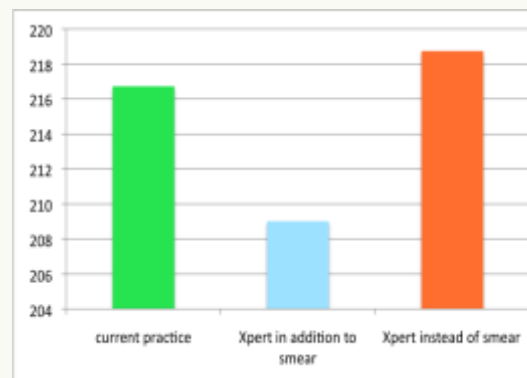
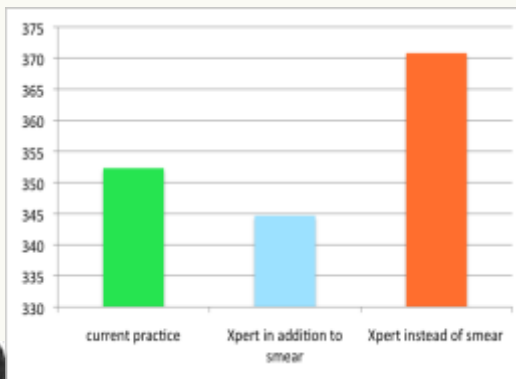
Uganda

South Africa

Diagnostic cost



Treatment cost



Cost per DALY

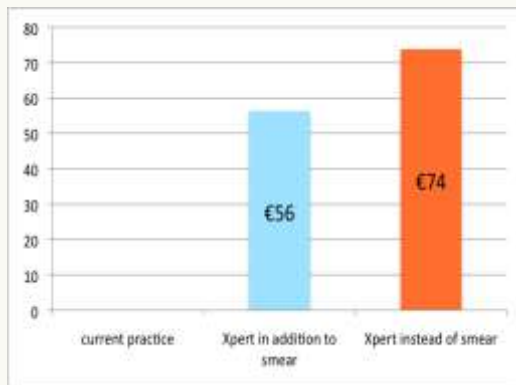
(Diagnosis and Treatment)(US\$2010)

Country	Baseline			In addition to Smear			Instead of Smear		
	Mean	(2.5)	(0.975)	Mean	(2.5)	(0.975)	Mean	(2.5)	(0.975)
Uganda	17.95	14.52	21.49	25.14	21.65	28.68	26.77	23.27	30.35
South Africa	78.05	65.65	90.53	80.60	67.65	93.67	88.76	74.52	103.16
India	31.96	24.72	39.14	34.96	28.08	41.81	37.44	30.53	44.34

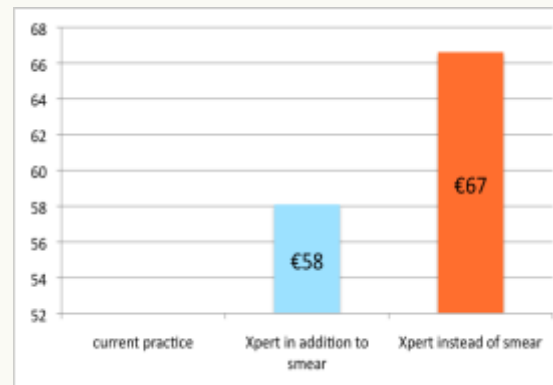
Confidence intervals generated through Monte Carlo analysis 10,000 iterations

Incremental Cost Effectiveness Ratio (Cost per DALY) (US\$2010)

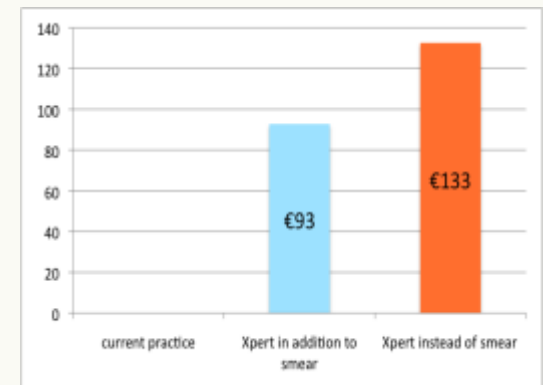
India



Uganda



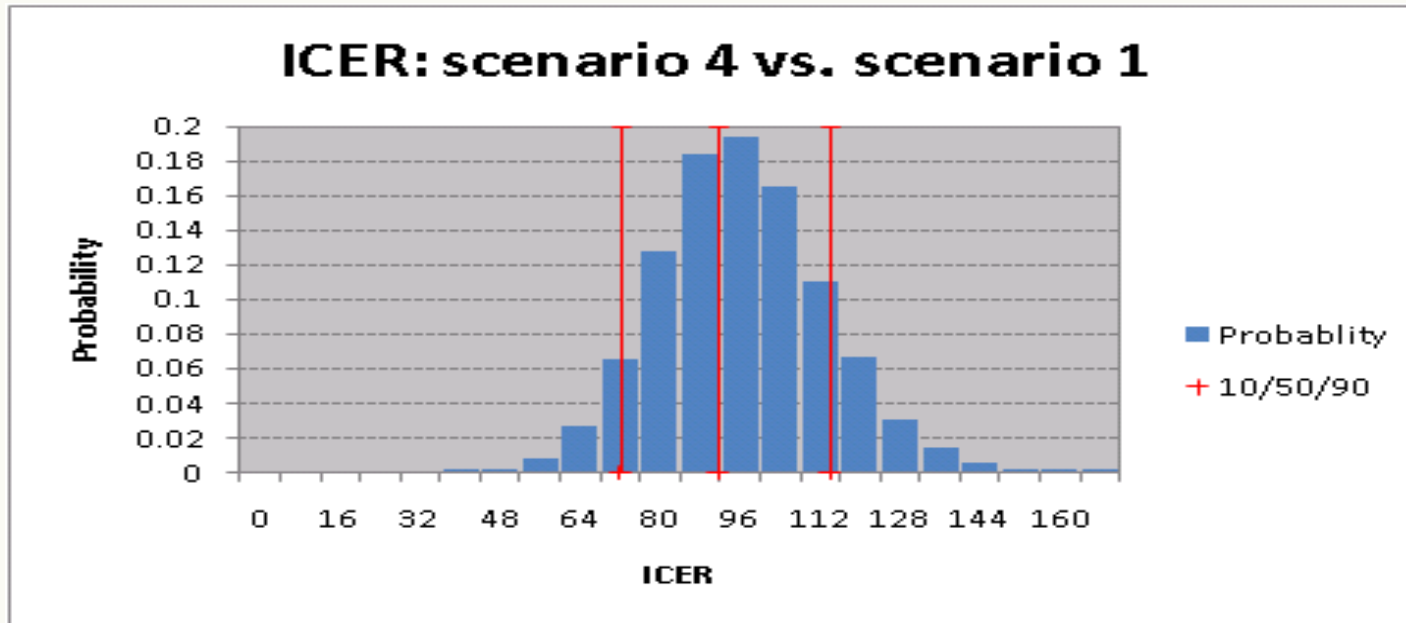
South Africa



Both compared to base case.

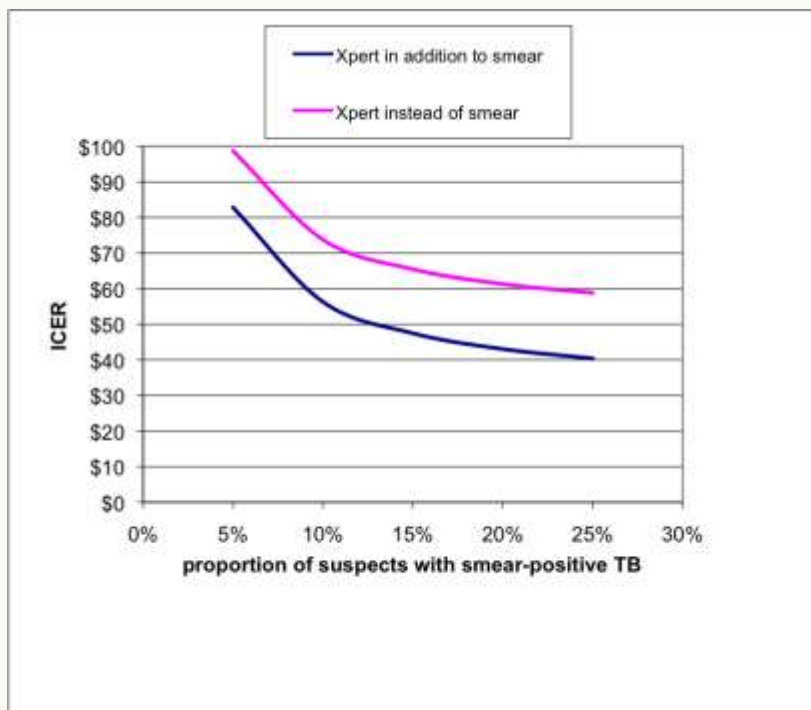
If 'instead of' compared to 'in addition to' then ICER very high
Eg. Uganda 1077 US\$2010 (but no transmission effect)

South Africa; in addition to example

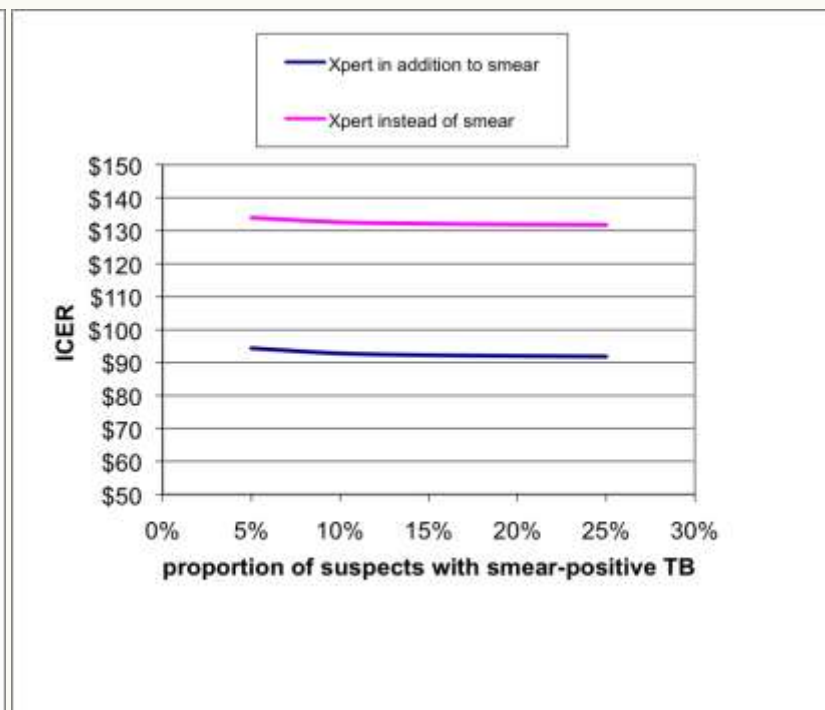


Sensitivity analyses – prevalence of sm+ TB among suspects

India

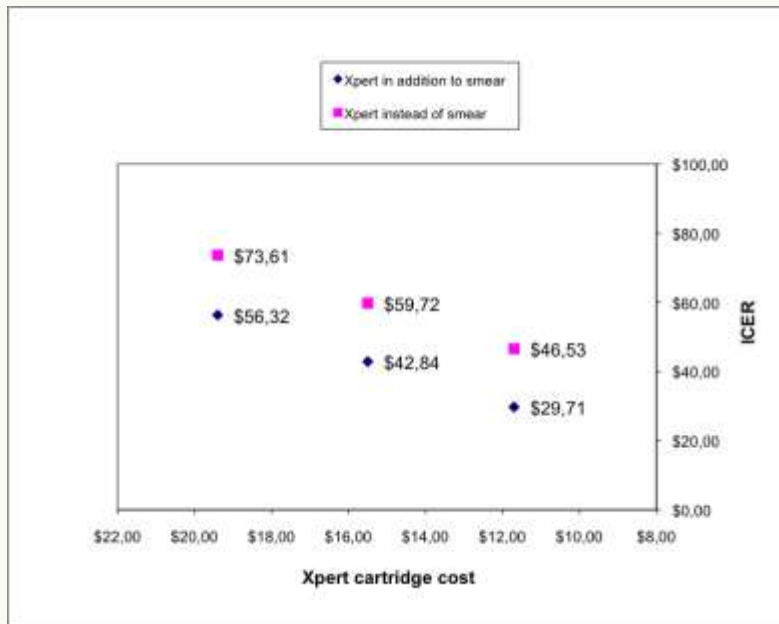


South Africa

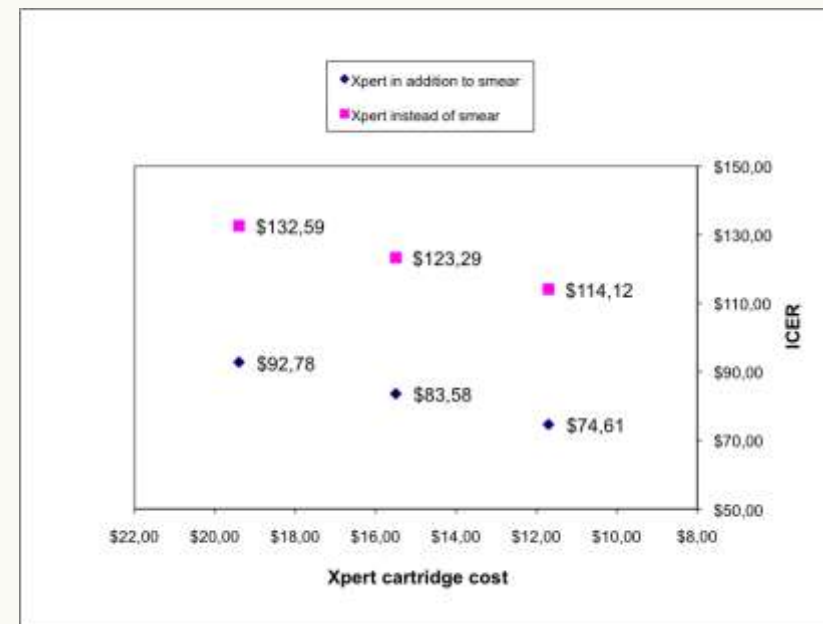


Sensitivity analyses – cartridge cost

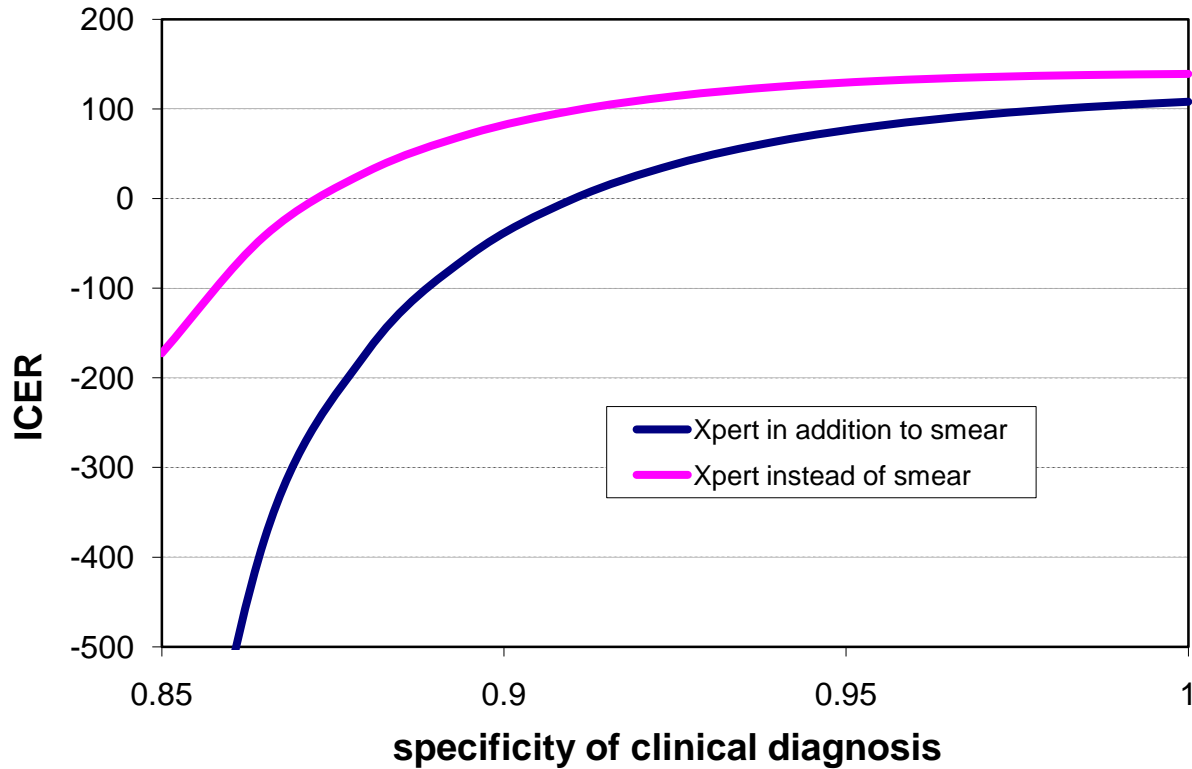
India



South Africa



**Incremental cost-effectiveness ratios (ICERs) for Xpert scenarios
compared to base case
SOUTH AFRICA**



Conclusion

In this simulation model including treatment effects and full costs:

1. Diagnostic scenarios in which XPERT is used in addition to or instead of smear examination strongly and equally increase TB case finding in all three epidemiological settings.
2. Both these scenarios yield more DALYs than the baseline scenario
3. The “Xpert instead of” scenario has higher cost per DALY gained than the “Xpert in-addition-to” scenario, partly due to the higher detection rate of MDR-TB cases and treatment costs involved.
4. Both these scenarios are cost-effective cf. WHO criteria compared to the base case

But...

- WHO threshold for acceptance may be higher than feasible budgetary reallocation constraints
 - Affordability/ funding streams
- Treatment costs
- Real gains in countries dependant on:
 - Suspect population
 - Current practices (in terms of the base case)
 - Number of people on ART
 - True incremental costs
 - HIV testing

→ requires careful further assessment and evaluation