Comparing the application of CEA and BCA to tuberculosis control interventions in South Africa

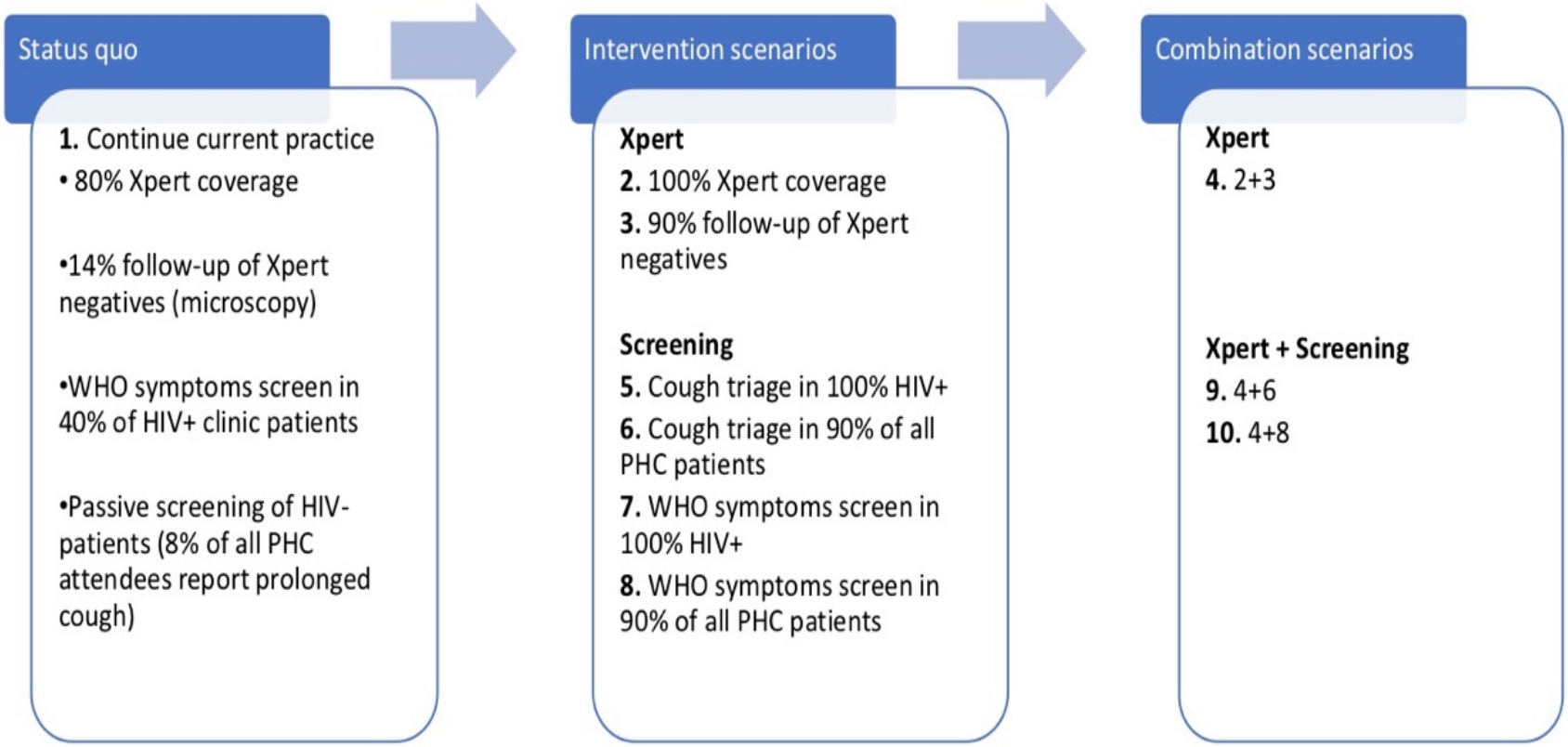
Tommy Wilkinson, Fiammetta Bozzani, Anna Vassall, Michelle Remme, Edina Sinanovic

Presenter: Tommy Wilkinson, Lecturer, Health Economics Unit, School of Public Health and Family Medicine, University of Cape Town

Background

- Tuberculosis (TB) is the leading cause of death in South Africa.
- In 2014, the South African TB Think Tank was established to advise the National Department of Health (NDoH) on policy and programmatic implementation of TB interventions
- Institutionalisation of economics and disease modelling to inform priorities for the national TB programme
- Economic evaluation conducted to inform the National Strategic Plan 2017-2022, employing the TIME (TB Impact Model Estimates)
- Conventional approach, estimating of incremental cost-effectiveness ratios (per DALY averted (Burden of Disease)) with and without constraints of different interventions

10 scenarios for TB case detection:



Applying the BCA guidelines

- Provide a test-case for the BCA guidelines
- Feasibility under data scarcity
- Would the results tell us or policy makers something new/ different than CEA?

	Costs	Health Impact	Summary Analytical Output
Cost Effectiveness Analysis	South African government Health system and TB program costs	Lives saved, DALYs averted	Incremental cost effectiveness ratios
Benefit Cost Analysis	South African government Health system and TB program costs, with third party costs represented as additional analysis	Valuation of mortality and morbidity risk reductions	Net benefits, return on investment

Data on costs and benefits

- Extensive primary data collection of TB costs
- Surveys of patients (direct costs and income loss)
- Programmatic data for coverage (baseline) (incremental)
- Effectiveness data systematic reviews and meta-analysis
- Incidence data and other data combination of secondary and primary data collection
- Conventional model calibration, extensive consultation with NDoH

Costs

	Intervention	Total 0% discount rate	Total 3% discount rate	Total 5.04% discount rate
2	100% Xp	$1 175	$836	$ 672
3	90% FU Xp -	$257	$183	$ 147
4	2&3	$1 464	$1 042	$ 838
5	100% HIV+ cough triage	-$1 807	-$1 241	-$971
6	90% PHC cough triage	$1 843	$1 314	$ 1 058
7	100% HIV+ SS	$9 504	$6 729	$5 394
8	90% PHC SS	$13 383	$9 494	$ 7 617
9	4&6	$3 468	$2 469	$ 1 987
10	4&8	$16 323	$11 570	$9 277

Total cost of interventions by element of the treatment pathway 2015-2035 at differing discount rates (in 2015 Int$, millions, incremental to status quo)

Value of statistical life: South Africa

- **Lack of data on WTP in SA, so conduct benefits transfer**
- Value of statistical life calculation:

$$VSL_{target} = VSL_{base} * (Income_{target} / Income_{base})^{elasticity}$$

- Income base is SA 2015 per capita income adjusted for purchasing power parity ($12,840), adjusted for income growth 2.52% over time
- Approach 1: ratio of GNI per capita to VSL estimates commonly used in the US ($9.1 million), with elasticity of 1 = Int$2 054 400
- Approach 2: ratio of GNI per capita to VSL estimates commonly used in the OECD ($2-3 million) with elasticity of 1 = Int$1 284 000
- Approach 3: approach 1, but using an elasticity of 1.5 = Int$ 981 652
- Value of statistical life year (VSLY) calculated by dividing VSL by mean undiscounted expected life years remaining for average South African adult (30.75 years)

Deconstructing the DALY:
Years Lived with Disability, Years of Life Lost

(Red area measures DALYs. Red + white is a “full and healthy” life)

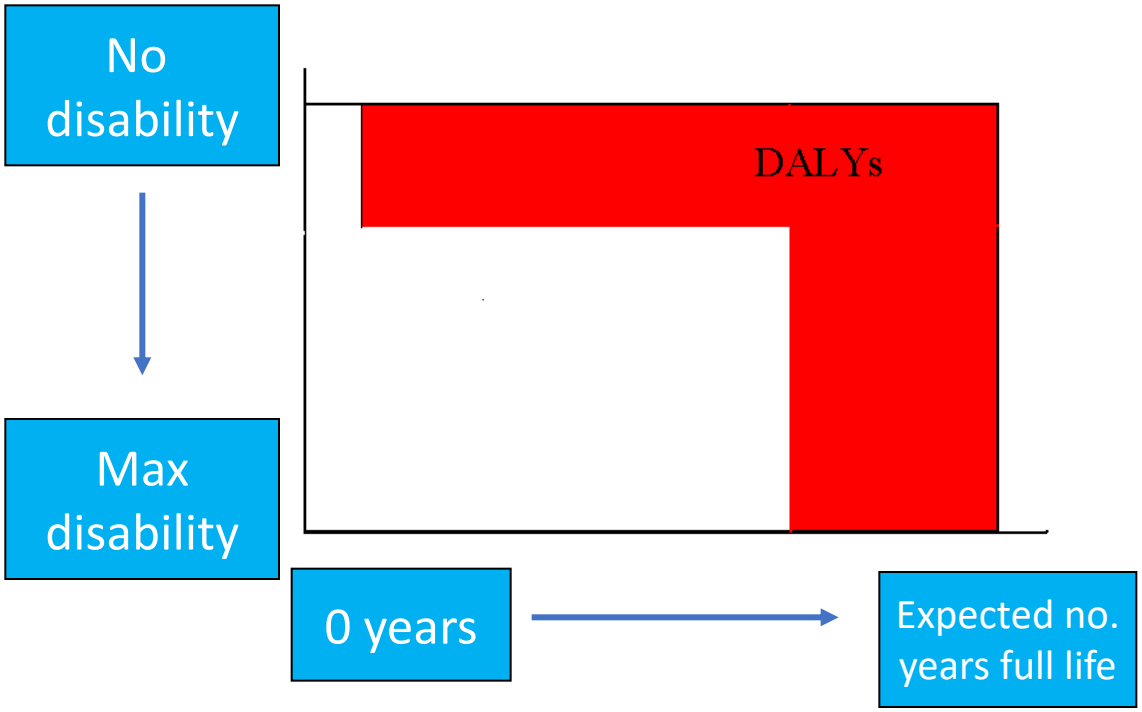
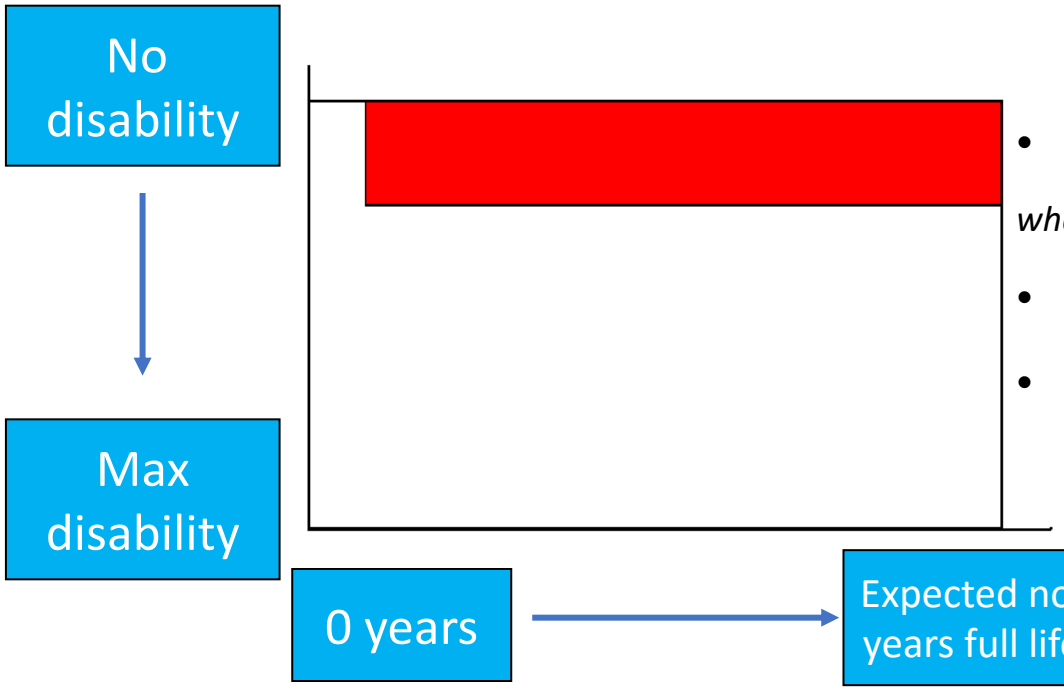


Figure adapted from Arnesen, Norheim

Deconstructing the DALY:
Deaths, Years Lived with Disability, Years of Life Lost



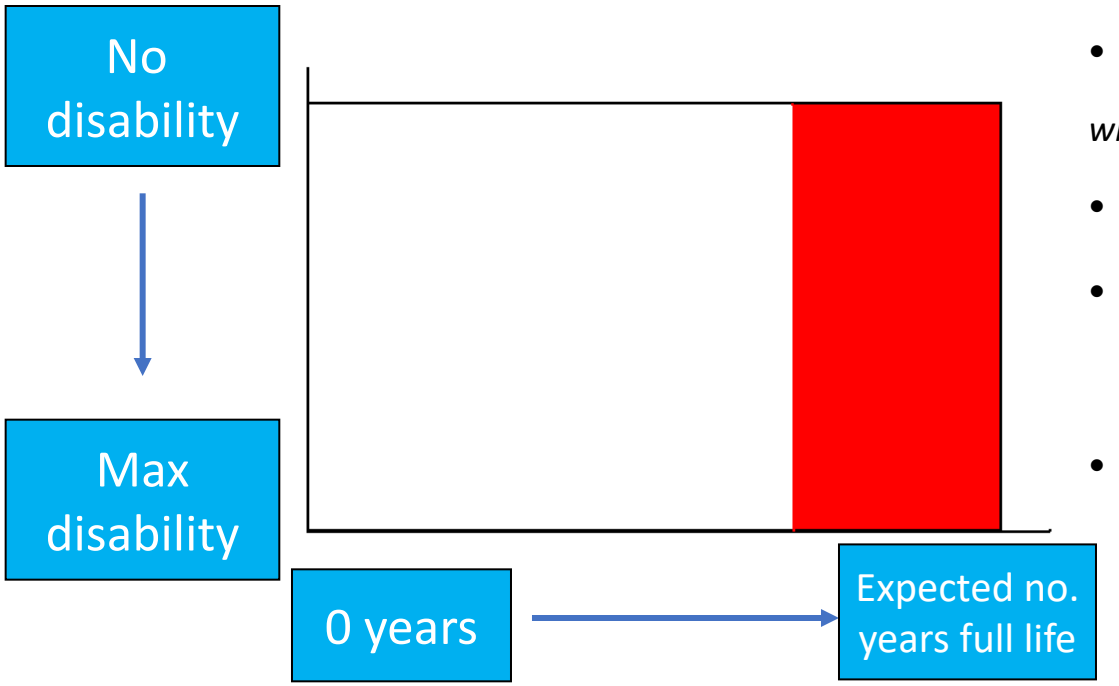
- Morbidity benefit = sum(YLD_t*$VSLY_t$)

where YLD is YLD averted incremental to status quo

- VSLY adjusted for growth at time = t
- Future benefit discounted at 3% to represent current value

Figure adapted from Arnesen, Norheim

Deconstructing the DALY:
Deaths, Years Lived with Disability, Years of Life Lost



- Mortality benefit=sum($death_t$*VSL_t)

where deaths are incremental to status quo)

- VSL adjusted for growth at time = t
- Future benefit discounted at 3% to represent current value
- In context where mortality is occurring very early or very late in life, can also use:

  Mortality benefit= sum(YLL_t*$VSLY_t$)

Net health benefits = Mortality benefit + Morbidity benefit

Figure acknowledgement Arnesen, Norheim

Benefits

	Intervention (incremental to status quo)	Total deaths averted	Monetized benefit of mortality risk reduction	Total YLD averted	Monetized benefit of morbidity risk reduction	Monetized benefit of morbidity risk reduction + 3rd-party costs)	Total monetized benefit (combined mortality and morbidity)
2	100% Xp	17 913	$19 351	24 309	$854	$930	$20 205
3	90% FU Xp -	5 170	$5 569	9 189	$321	$303	$5 891
4	2&3	22 780	$24 597	34 203	$1 201	$1 257	$25 798
5	100% HIV+ cough triage	1 769	$1 832	5 047	$174	$233	$2 006
6	90% PHC cough triage	15 571	$16 827	14 815	$521	$494	$17 347
7	100% HIV+ SS	35 775	$38 490	52 771	$1 842	$1 615	$40 333
8	90% PHC SS	55 429	$59 912	53 039	$1 865	$1 557	$61 778
9	4&6	37 237	$40 213	48 181	$1 692	$1 739	$41 905
10	4&8	73 970	$79 903	83 701	$2 941	$2 835	$82 844

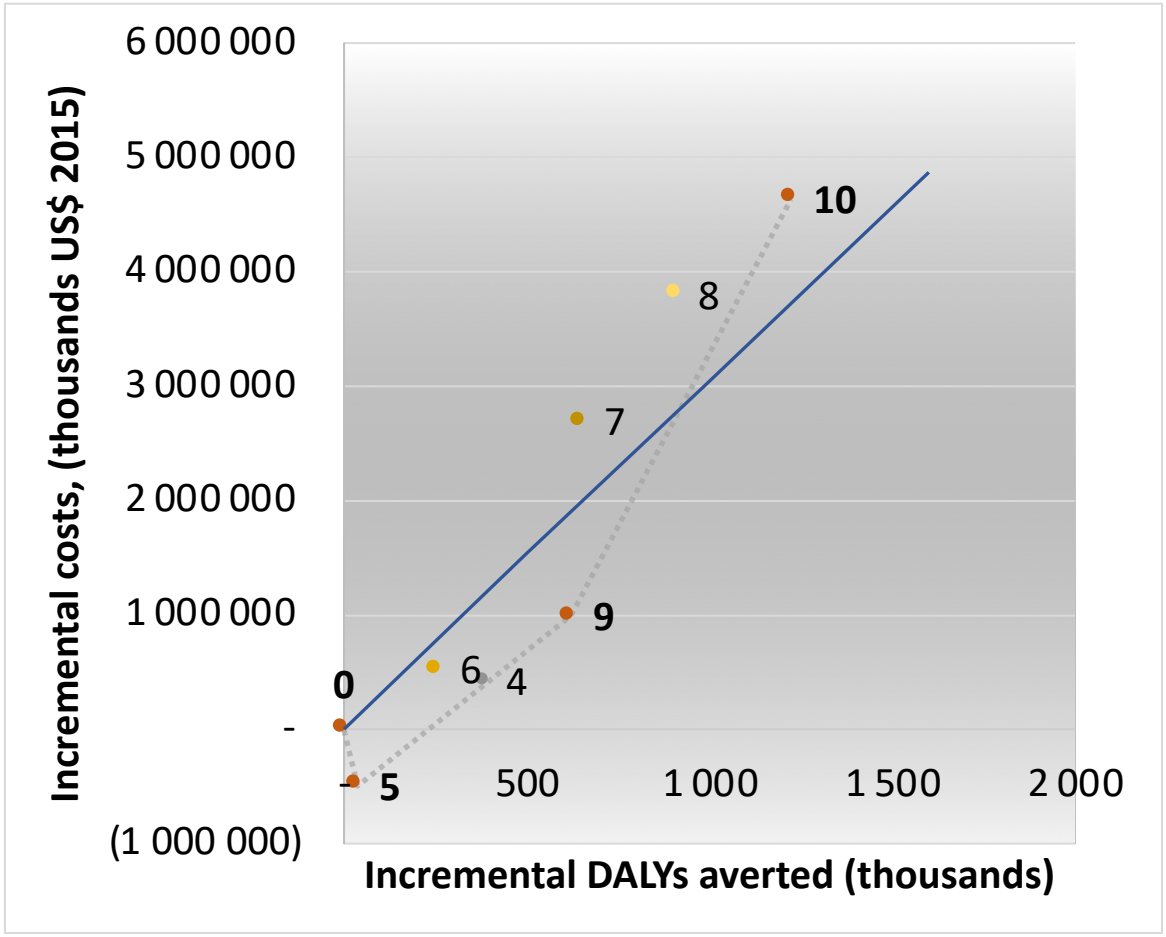
Total monetized benefit by mortality and years lived in disability incremental to status quo 2015-2035 (in 2015 Int$, 'millions)

Net benefits and RoI

	Intervention	Net benefit (Int$)	Net benefit (ZAR)	Return on Investment
2	100% Xp	$19 369	R107 770	21
3	90% FU Xp -	$5 708	R31 757	28
4	2&3	$24 756	R137 741	21
5	100% HIV+ cough triage	$3 247	R18 067	>100
6	90% PHC cough triage	$16 033	R89 210	11
7	100% HIV+ SS	$33 603	R186 969	5
8	90% PHC SS	$52 284	R290 907	6
9	4&6	$39 436	R219 420	15
10	4&8	$71 274	R396 570	6

Net benefit and RoI by intervention, incremental to status quo 2015-2035 (in 2015 Int$ millions and ZAR millions)

ICERs, unconstrained



4. Xpert utilisation + Xpert negative algorithm
5. Cough triage in 100% of known HIV+ clinic attendees
6. Cough triage in 90% of PHC attendees
7. Symptom screen in 100% of known HIV+ clinic attendees
8. Symptom screen in 90% of PHC attendees
9. 4 + 6
10. 4 + 8

ICER expansion path

WTP = half GDP

Interpreting Results:

- CEA (decision rules based on opportunity cost threshold and expansion path)
  - Int. 9 Invest in Xpert with follow-up and cough triage, Int 5 and 10 potential policy options

- BCA (decision rule maximize welfare gain)
  - Int. 10: Highest net benefit under all approaches to VSL calculation, but a relatively low RoI
  - Investment in the above but replace cough triage with symptom screen

- **Both are "correct", but measuring differing things**
- **Presentation and policy translation will determine interpretation and potentially policy responses**

Discussion: Methods

- Given historical and persistent levels of inequity and access to care in South Africa:
  - To what extent is a monetized value of individual preferences for changes in one's own risks valid in determining health policy?
  - How can the objective function to maximise health under a budget constraint be balanced against other social values?
- Intervention in TB is driven by mortality prevention:
  - But would it be consistent to assume the value of disability compared to death is the same as value of risk of disability to risk of death?
- Valid in South Africa for intersectoral resource allocation?
  - Likely, but more BCA evaluations required
  - But does either analytical approach sufficiently focus the issue on the constraints to health sector budget, capacity to deliver?
- Income growth assumptions in long term in South Africa
- **Credibility and complexity for non-economist decision makers (even if only advocating with the Treasury)**

Which method?

"Ultimately, the validity of the differing approaches rests on the requirements, understanding, and informational needs of the intended decision maker, and the realities of local perspective, and context"

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