Are current cost-effectiveness "thresholds" for low- and middle-income countries useful?

Examples from the world of vaccines

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Outline

- Why do we need “thresholds”?
- What “thresholds” are appropriate?
  - ‘Demand side’ estimates
  - ‘Supply side’ estimates
- Examples
- Discussion & Conclusion

Why do we need “thresholds”?

- All healthcare systems face difficult decisions regarding how to allocate scare resources to generate improvements in population health
- There is an **opportunity cost** to everything that is done by government, donors etc.
  - No such thing as “free lunch”

Why do we need "thresholds"

- Whether a health intervention (e.g., vaccine, technology, drug, device) should be funded depends upon the total health it generates and how much it costs
  - Commonly summarized as a cost-effectiveness ratio

$$ICER = \frac{\Delta C}{\Delta E}$$

  - Requires comparison with a benchmark value or "threshold" (i.e., fund if below threshold, do not fund if above)

What "thresholds" are appropriate?

- Confusion is evident in the values recommended or cited by decision making and advisory bodies

- Failure to distinguish clearly between **'demand side'** (what the value of health and health care expenditure should be) and the **'supply side'** (what improvement in health is possible given existing resources)

‘Demand side’ estimates

- Seek to inform the social value of health (i.e., what society ought to pay for improvements in health)
- Generally based on evidence of how much consumption individuals are willing to give up to improve their health
- Recommended by some agencies, e.g., World Health Organization WHO-CHOICE “thresholds”
  - < 1x GDP pc is highly cost effective; < 3x GDP pc is cost effective; > 3x GDP pc not cost effective
  - Used as generic and internationally applicable criteria to classify interventions

‘Demand side’ estimates

- Widely recognised as having shortcomings (Newall et al. 2014; Marseille et al. 2015; Robinson et al 2016; Bertram et al 2016; Revill et al 2014)
  - Reduce overall population health and exacerbate healthcare inequalities
  - Fail to identify the real (and potentially much greater) value of devoting more resources to health care
- ‘Demand side’ estimates are typically higher than ‘supply side’ estimates of the marginal productivity of health spending (Vallejo-Torres et al, 2016; Ryen and Svensson, 2015)
- Conceptually and numerically different, therefore result in different decisions

‘Supply side’ estimates

- Represent health opportunity costs of marginal changes in expenditure where changes are funded either through:
  - additional resources or
  - disinvestment in existing commitments
- Can be obtained from estimates of the health effects of changes in health expenditure (Martin et al, 2008, 2012; Claxton et al, 2015)
- Estimates available for LMICs (Woods et al, 2016; Ochalek et al, 2015)

‘Supply side’ estimates

- Useful for:
  - Government decision makers
  - Donors contributing to the overall funding of a health care system or toward specific interventions or programs
  - Donors looking to fund the development of new health interventions
  - Prioritising between a set of cost-effective interventions
  - Deciding maximum spend to implement a cost-effective intervention

Example based on Malawi

- 'Supply side' estimate of the productivity of health spending at the margin
  - $61/DALY averted (2016 US$) (Woods et al, 2016; Ochalek et al, 2015; Ochalek et al, 2016)
- 'Demand side' value based on GDP per capita
  - $381/DALY averted (1x GDP per capita 2015 US$)

- Hypothetical Intervention A
  - ICER $150/DALY averted

Example based on Malawi

Net DALYs averted = DALYs – costs / 61

- Hypothetical intervention A: ICER $150/DALY averted (costs $1,500 and averts 10 DALYs per patient)

Table 1. Costs, DALYs averted and Net DALYs averted by hypothetical intervention

Patients	Cost	DALYs averted	Net DALYs averted
1	$ 1,500	10	-15

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Patients	Cost	DALYs averted	Net DALYs averted
1	$ 1,500	10	-15
10,000	$ 15,000,000	100,000	-145,902

Example from the world of vaccines: Rotarix

- Taken from Berry et al (2010) “The Cost-Effectiveness of Rotavirus Vaccination in Malawi”
- Time horizon: 2 years ~90% of Malawian children infected at least once by their second birthday, repeat infections less serious as immunity is built up
- DALYs: mortality data and mean duration of diarrhoea of 5 days
- Costs: Program cost (cold chain, transportation, personnel time, and stationery), outpatient visit cost, wastage rate of 10%

Example from the world of vaccines: Rotarix

Table 2a. Costs and Outcomes from a Rotarix Vaccination Program under GAVI Alliance and Market Vaccine Pricing for a birth cohort of 582,211

	Cost per DALY averted ICER		Net DALYs averted			
	GAVI	Market	GAVI	Market		
Rotarix vs no vaccination	$ 5	$ 75	72,502	- 17,804		

Adapted from Berry et al, 2010

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Example from the world of vaccines: Rotarix

Table 2b. Costs and Outcomes from a Rotarix Vaccination Program under GAVI Alliance and Market Vaccine Pricing for a birth cohort of 582,211

	Cost per DALY averted ICER		Net DALYs averted		$ value to the health care system	
	GAVI	Market	GAVI	Market	GAVI	Market
Rotarix vs no vaccination	$ 5	$ 75	72,502	- 17,804	$ 4,422,620	$ -1,086,067

Adapted from Berry et al, 2010

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Discussion

- In this example, would approve Rotarix under GAVI pricing structure
- Can rank Rotarix among other candidate vaccines/interventions by net DALYs averted in order to prioritize the vaccines/interventions that generate the largest gains in overall population health
- Can determine the maximum we should spend on implementation costs over and above the cost of Rotarix

Conclusion

- An estimate of health opportunity costs is crucial
- 'Demand side' estimates cannot tell us about the opportunity cost imposed by an intervention
- There are often substantial differences between supply and demand side estimates so which one is used matters

Example from the world of vaccines: Rotarix

Table 1. Costs and Outcomes from a Rotarix Vaccination Program under GAVI Alliance and Market Vaccine Pricing for a birth cohort of 582,211

	Cost			Net cost			Cost per DALY averted		Net DALYs averted	
	GAVI	Market	Treatment costs	GAVI	Market	Total DALYs	GAVI	Market	GAVI	Market
No vaccination	$ 0	$ 0	$ 187,211	$ 187,211	$ 187,211	183,445				
Rotarix	$ 482,069	$ 5,990,756	$ 106,463	$ 588,532	$ 6,097,219	104,365				
Difference vs no vaccination	$482,069	$ 5,990,756	$ 80,748	$ 401,321	$ 5,910,008	79,081	$ 5	$ 75	72,502	- 17,804

Adapted from Berry et al, 2010

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