bode³
Burden of Disease Epidemiology, Equity and Cost Effectiveness Programme

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User Guide for
EMIC Calculator-International

What this calculator does

This calculator can be used to estimate the maximum amount society could invest upfront in a life-saving intervention at different ages, while remaining cost-effective (for differing thresholds of "cost-effectiveness"). We term this upfront amount "estimated maximum intervention cost" or EMIC, and it is calculated from a health system perspective. This version calculates EMICs for different countries using World Health Organization (WHO) country-specific data on health system expenditure, morbidity, and mortality.[1,2] The death prevented by the life-saving intervention here is not one from a pre-existing chronic disease that reduces life expectancy. Rather, it is death from a relatively acute 'short and sharp' disease or injury, where the intervention saves their life and then returns them to expected health, having the same average morbidity and mortality as the average citizen of their age and sex.

What to use it for

This calculator can be used to rapidly estimate the maximum amount society should spend (for different ages) on treatment interventions for acute conditions such as life-threatening infectious diseases, or highly curable cancers of short duration such as acute leukaemia or testicular cancer.

How it works

For more information on the methods and rationale behind this calculator, please refer to the associated article and its appendix, or email the designer Dr Giorgi Kvizhinadze (email: giorgi.kvizhinadze@otago.ac.nz). Behind this calculator is WHO country-specific data on age and sex-specific mortality, morbidity, and health system costs. It also relies on several critical assumptions which are outlined further on in this document.

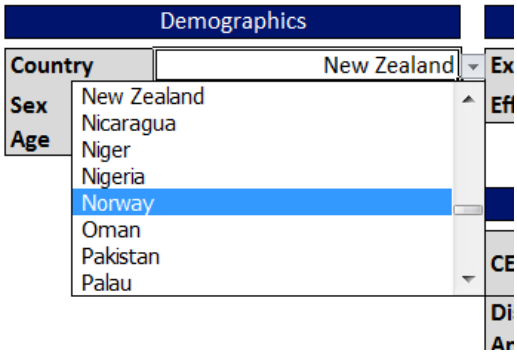
How to use this calculator

The white cells are the input cells, which require you to enter specific information. The yellow cells are the results cells, showing the EMICs calculated using your inputs and WHO data. You may have a specific life-threatening condition and life-saving health intervention in mind, or you may just like to enter in different values and play around to get a sense of the EMICs for different scenarios.

The following section is a step-by-step guide:

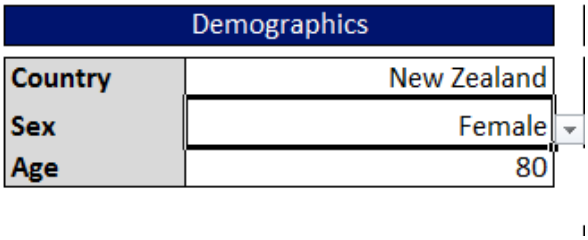
INPUTS

Step 1: **Select the country of interest using the drop-down menu**



Step 2: **Select the sex and enter the age you want**

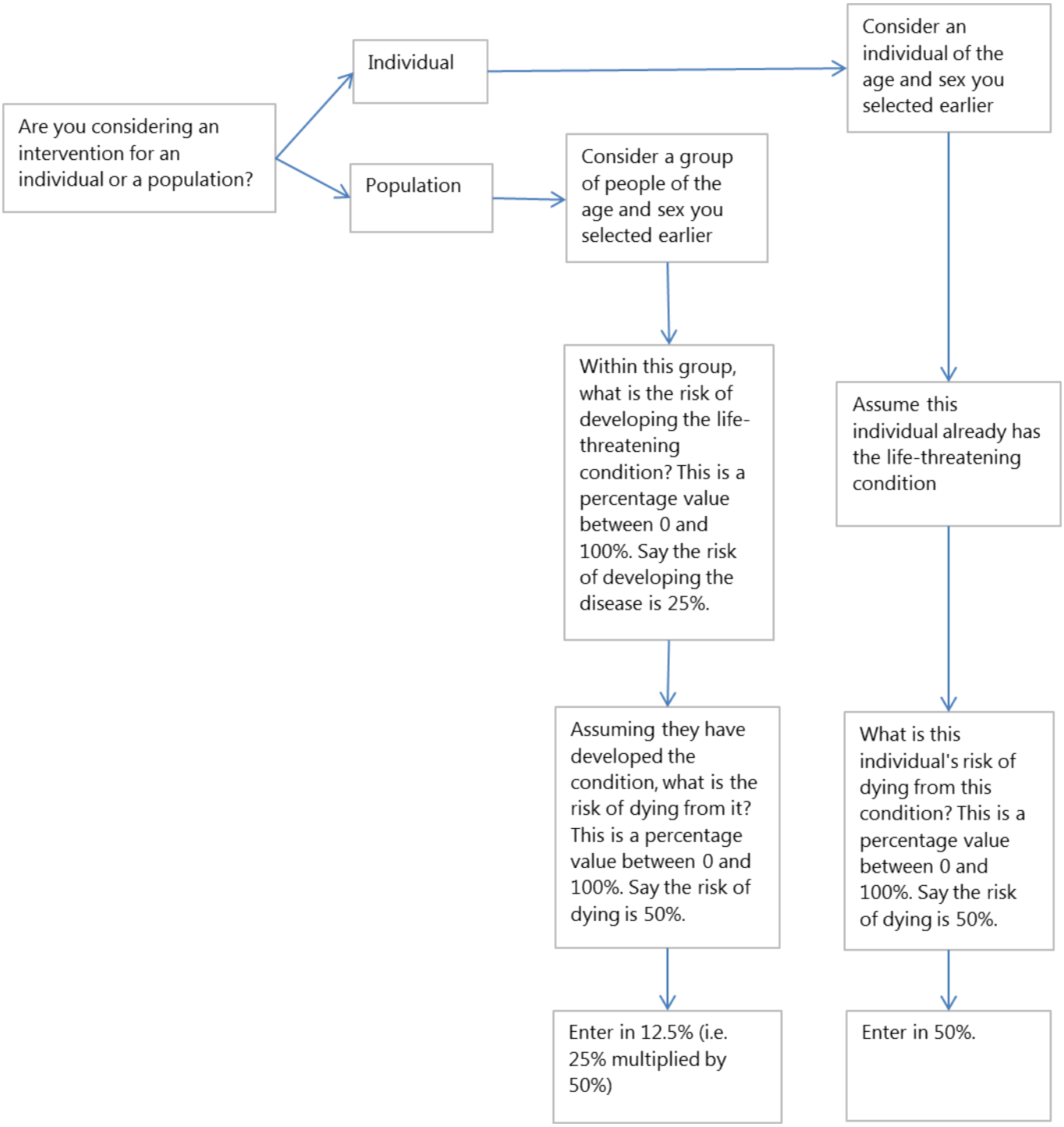
The EMICs will vary markedly by the sex and age of the population or the individual eligible for your intervention. Use the drop-down menu to select sex (either Male or Female) and type in the age in years (from 0 years to 105 years inclusive).



Step 3: **Enter in your risk parameters**

Risk Parameters	
Extra risk of death without treatment	1.0%
Effectiveness of treatment in reducing risk of death	100.0%

Extra risk of death: This calculator assumes the risk of death from the life-threatening condition is imminent i.e. within the next year. Extra risk of death is that excess risk of death from the life-threatening condition in question, over and above the background or “normal” risk of dying in someone who did not have that condition. This is a percentage value from 0% to 100%. In order to work out what goes into this cell, use the simple algorithm below.



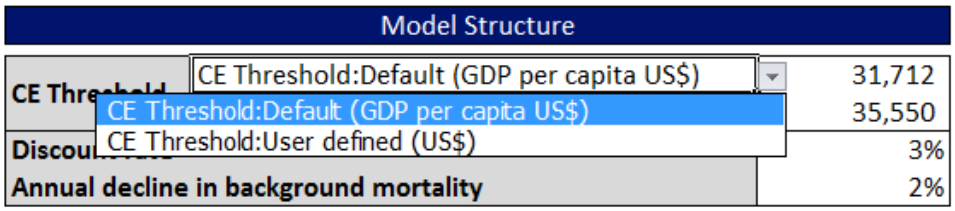
Effectiveness of treatment in reducing the risk of death: This refers to the effectiveness of the intervention being considered, as a percentage value from 0% to 100%. Assuming the risk of death from the life-threatening condition is 100%, how effective is the intervention in reducing this risk? If it eliminates the risk of death completely, then effectiveness is 100%. If it halves the risk of death, then effectiveness is 50%.

Step 4: **Select or enter in your preferred cost-effectiveness threshold**

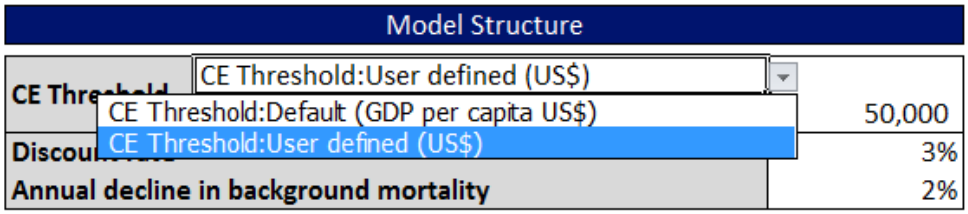
Model Structure			
CE Threshold	CE Threshold:Default (GDP per capita US$)	$	31,712
	Ignore cell to the right	$	35,550
Discount rate			3%
Annual decline in background mortality			2%

The cost-effectiveness threshold is how much society is willing to pay to gain one health-adjusted life-year (HALY), or one year in full health. Use the drop-down menu to select **either:**

- the default cost-effectiveness threshold, which is your country's gross domestic product (GDP) per capita in US$ (filled in automatically for you) **or**



- a user-defined cost-effectiveness threshold, which then prompts you to enter your own cost-effectiveness threshold in the cell below, in US$ (per HALY gained).



Step 5: **Enter in your preferred discount rate**

Model Structure			
CE Threshold	CE Threshold:User defined (US$)		
	Enter alternative CE threshold (US$ per HALY)	$	50,000
Discount rate			3%
Annual decline in background mortality			2%

As per standard health economic approaches, a benefit or cost in future years has a lower present-day value (along the lines of the saying "a bird in the hand is worth two in the bush."). Therefore future health gains and future costs need to be converted to their present-day value. The rate at which this is done is called the discount rate. As the discount rate increases, future health gains and costs become less

important when compared with the present. Enter in your preferred discount rate in this cell as a percentage. Common discount rates used in health economic analyses are 3% and 6%, or you may prefer not to discount at all (0%).

Step 6: **Enter in your preferred background mortality rate (BMR) trend**

Model Structure		
CE Threshold	CE Threshold:User defined (US$) Enter alternative CE threshold (US$ per HALY)	$ 50,000
Discount rate		3%
Annual decline in background mortality		2%

This cell is about improving life expectancy (or decreasing 'normal' or background mortality rate) over time. Enter in how much you anticipate the background mortality rate to decline each year until 2026, as a percentage. After 2026, an automatic decline of 1% is applied given the ongoing improvements in life expectancy that have been occurring in most countries in recent decades.

RESULTS

RESULTS

EMIC (US$)	$1,170
EMIC (local currency as per country)	1,732

The yellow cells contains EMIC estimates based on your country's WHO data on life expectancy, population morbidity, and health system costs-for the population and level of risk you have specified, and given your preferred assumptions. EMIC estimates are provided both is US$ as well as in the local currency of the country you have selected.

Critical assumptions and limitations

The user should note that this calculator is a fairly simplistic tool. There are several critical assumptions and limitations:

- This calculator is for considering life-saving interventions in relatively acute "short and sharp" diseases or injuries, where the intervention saves their life and then returns them to expected health, having the same average morbidity and mortality as the average citizen of their age and sex. It does not apply to pre-existing chronic diseases which reduce life expectancy.
- We approach this from a health system perspective so we only consider health system costs and do not include economic productivity, etc. So from a societal perspective that did consider the benefits of workers to the economy – higher EMIC values would be obtained.
- The default results are for the New Zealand context, with scaling up or down performed as necessary. In general, this calculator is likely to be more accurate for developed, high-income countries like NZ, because of the following assumptions:
    - The distribution of health costs by age and sex is that for NZ, and when the scaling is done, this pattern holds. You will need to judge if the country you have selected has similar health

spending patterns to NZ, such as spending relatively large amounts of health system funds on older citizens.

- The above also applies for mortality by age and sex, as well as morbidity. You will need to judge if the country you have selected has similar morbidity and mortality patterns to NZ, for example relatively low morbidity at younger ages and relatively low maternal morbidity.
- We also assume that the age structure of other countries is similar to NZ. Again, you will need to know if the country you have selected has a similar age structure to NZ.[3]

A Worked Example

Question: In the New Zealand context, how much is it worth spending (while remaining cost-effective) to save the life of a 5-year-old girl using a new 100% effective pandemic influenza vaccination, and similarly an 80-year-old women using this same vaccine (when the extra risk of death is 0.1% and 1% respectively in year one of the pandemic)? What about in China?

Country	**New Zealand**		**China**	
	5-year-old girl	*80-year-old woman*	*5-year-old girl*	*80-year-old woman*
Heterogeneity				
Sex	Female	Female	Female	Female
Age	5	80	5	80
Risk Parameters				
Extra risk of death	0.1%	1%	0.1%	1%
Effectiveness of treatment	100%	100%	100%	100%
Model Structure				
CE Threshold	GDP per capita (US$ 31,712)	GDP per capita (US$ 31,712)	GDP per capita (US$ 10,041)	GDP per capita (US$ 10,041)
Discount rate	3%	3%	3%	3%
Annual decline in BMR	2%	2%	2%	2%
RESULTS				
EMIC (US$)	US$ 713	US$ 697	US$ 195	US$ 52
EMIC (local currency)	NZ$1,056	NZ$ 1,032	CNY$ 1,258	CNY$ 334

Answer: In NZ, given these inputs, it would be worth a government spending up to US$ 713 on purchasing and delivering such a pandemic vaccination per 5-year-old girl and up to US$ 697 per 80-year-old woman. Corresponding values for China would be US$ 195 and US$ 52.

We welcome feedback on improving this calculator and its supporting documentation. Please email the designer, Dr Giorgi Kvizhinadze (email: giorgi.kvizhinadze@otago.ac.nz).

References

1. World Health Organization. Global Health Observatory Data Repository: Life Expectancy Data by Country. 2014. http://apps.who.int/gho/data/node.main.688?lang=en (accessed September 15 2014).
2. World Health Organization. Global Health Observatory Data Repository: Health expenditure per capita-Data by country 2014. http://apps.who.int/gho/data/node.main.78?lang=en (accessed September 15 2014).
3. United Nations. World Population Ageing New York: United Nations 2013.