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A new online calculator for estimating how much a society might spend on life-saving interventions

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Giorgi Kvizhinadze, Nick Wilson, Nisha Nair, Melissa McLeod, Tony Blakely

In this blog we describe an online calculator we developed to estimate the maximum investment society might consider spending on life-saving health interventions, while remaining cost-effective. For NZ, the amounts generated by this calculator vary greatly by age: NZ$ 1.2 million for an intervention to save the life of a child, NZ$ 0.7 million for a 50-year-old, and NZ$ 0.2 million for an 80-year-old, assuming we are willing to spend $45,000 per healthy life-years gained and the person is returned to the expected health status of the average NZ citizen. These results are very sensitive to the choice of discount rate and to the selected cost-effectiveness threshold. Policy-makers could use this calculator as a rapid screening tool to determine if more detailed cost-effectiveness analyses of potential life-saving interventions might be worthwhile.

Many countries spend a substantial proportion of their gross domestic product (GDP) on health, e.g., at least 10% in countries like as NZ. Furthermore, the ongoing rise in health spending at a rate faster than GDP growth (the result of: income growth, new technologies, population growth, and ageing), is unlikely to be sustainable in the long term. Given this picture, health sector policy-makers need to take increasing care in allocating finite health resources in ways that maximise health benefits for the population.

In an ideal world (and taking only a cost-effectiveness point of view) such health policy-makers would have the results of studies that identified the country-specific societal preference for saving a life or gaining a life-year at different ages. In such an ideal world, they would also have a league table of life-saving and health-gaining interventions to inform the “next best” intervention to adopt from a cost-effectiveness perspective. But most countries (including NZ) are a long way from having such information available and most also have limited resources for conducting new cost-effectiveness analyses. Such analyses can also take many months and cost tens of thousands of dollars per intervention modelled.

Given these issues, we aimed to build an online calculator to help inform policy-makers so that they could more readily determine if more detailed cost-effectiveness analyses of potential life-saving interventions might be worthwhile. For simplicity we focused on just cost-effectiveness, but we note that this is just one component of appropriate decision-making and that many other components might be reasonably considered to be important e.g., equity impacts, public acceptability, and feasibility (as outlined by Pharmac).

Methods for building this calculator

In this work we specifically aimed to build an online calculator to determine the "estimated maximum intervention cost" (EMIC) that a society could invest in a life-saving intervention at different ages, while remaining cost-effective according to a selected cost-effectiveness threshold.

The underlying model is a simple lifetable with average population health system costs and morbidities attached as "rewards" in alive and dead states. The detailed methods are described in this online (full free text) journal article. But to summarise, we used data from NZ life tables and morbidity data from a burden of disease study was used to estimate health-adjusted life expectancy after the life-saving intervention, equivalent to health-adjusted life-years (HALYs) gained from preventing death. Health system costs were estimated from a national database of all publicly-funded health events (hospitalisations, outpatient events, pharmaceuticals, etc). It is up to the user to specify their cost-effectiveness threshold, but the user may wish to start with the WHO-CHOICE approach of the gross domestic product (GDP) per capita (NZ$45,000 per HALY). The intervention is assumed to return survivors to "expected" health, with the same average morbidity and mortality trajectory as the rest of their cohort, and the same future HALYs and costs (i.e., no long-term health sequelae of the life-threatening health event).

To internationalise the calculator, we used available WHO data on health-adjusted life expectancy and World Bank data on GDP and health expenditure for each country in the world. The resulting calculator allows researchers and policy-makers to derive their own country-specific EMICs by selecting their country from a drop-down list, specifying the risk of death in the disease being considered as well as the effectiveness of the life-saving intervention, and selecting their preferred cost-effectiveness threshold. Nevertheless, the calculator is still relatively simplistic and we highlight to users that they should be aware of several critical assumptions (outlined in an online user guide).

What do the results show for NZ?

The EMIC to save a life (where the person then returns to the health status of the average citizen of the same age and sex) while remaining cost-effective was found to vary markedly by age for all countries. For NZ, using a $45,000 per healthy life year saved threshold and a 3% discount rate, the EMIC was NZ$1.2 million to save the life of a child, $0.7 million to save the life of a 50-year-old, and $0.2 million to save the life of an 80-year-old (see Figure in the online article). There was also substantial variation using different cost-effectiveness thresholds e.g., at a discount rate of 3%, the maximum amount to spend to save a child's life increases to $1.46 million for a cost-effectiveness threshold of $55,000 per HALY and decreases to $916,000 (30%) for a threshold of $35,000 per HALY. There was also large variation when using the 0% and 6% discount rates.

Comment on these results

This variation in EMIC results with age is not surprising given the central role that remaining life expectancy plays within the metric of health-adjusted life expectancy (the basis of this calculator). Some people might object to this and so we would favour societal discussion of this topic (e.g., by way of surveys or citizen juries). But we also suspect that many people would favour spending relatively more of a society's limited resources to save the life of a young person – given the principle of giving them a "fair go" at the start of their lives, whereas a 90-year-old might be regarded as having had a reasonably "fair innings".

Of course this variation by age is due to the life-saving intervention returning a person certain to die otherwise, back to average health for that sex and age. If the intervention extended life by two years for all ages, then it would only slightly favour younger people; as older people have higher expected co-morbidity, two years is worth a bit 'less' for an older person. Likewise, for an intervention that gains fewer years, does not return the person to full health, or has a less than 100% probability of saving the life, the amount a society should spend from a health system perspective is (often considerably) less. For the adventurous user, we have also developed a generalised calculator for such variations (and one which has more cancer-specific data). We would greatly appreciate user-feedback on the usefulness of these, and also the usefulness of the EMIC calculator (email kate.sloane@otago.ac.nz).

But back to the health economic decision-making process. Of course policy-makers often need to make decisions about which new health interventions to adopt or reject, and often quickly. These decisions are and should be based on multiple criteria, of which cost-effectiveness is just one (e.g., as discussed above equity is also important). But it is envisioned that calculating an EMIC for a potential intervention might be potentially useful as a rapid screening process – to determine if spending limited resources on conducting more detailed cost-effectiveness analyses might be worthwhile or if the proposed interventions are very unlikely to benefit from such additional research. For example, using the NZ results, if a life-saving intervention appears likely to cost many times more than NZ$ 1.3 million per life saved, then it might be unlikely to be found to be cost-effective upon further more detailed research in this setting for any age group (using a threshold of NZ$ 45,000 per HALY). Along the same lines, if a potential intervention costs far more than NZ$ 400,000 per life saved, further research may be unlikely to find it to be cost-effective in the 70-plus age-group.

Conclusions

We have developed an online EMIC calculator (and a more generalised calculator) that takes one possible approach to estimating maximal cost-effective investment in life-saving health interventions, under various assumptions. Despite the various limitations with this work, busy policy-makers could use this calculator as a rapid screening tool. This could help them determine if more detailed cost-effectiveness analyses of potential life-saving interventions might be worthwhile or which proposed interventions are very unlikely to benefit from such additional research. We welcome feedback, through posts to this blog or direct contact with a member of the BODE^3 team.

Authors:
By the BODE^3 Programme Team

Dr Giorgi Kvizhinadze, A/Prof Nick Wilson, Dr Nisha Nair, Dr Melissa McLeod, Prof Tony

Blakely (all at: Department of Public Health, University of Otago, Wellington).

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