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RESEARCH NOTE

Quantifying the wellbeing costs of COVID-19

THE NEW ZEALAND INITIATIVE

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Summary

In deciding whether to extend the current lockdown, the government must balance the likely benefits of reduced sickness and deaths against the cost of lost national income and jobs. To do so systematically requires an analytical framework that organises the available information.

A preliminary model illustrating how this can be done was published in 2017 by five of New Zealand's leading epidemiologists and colleagues.[1] This research note does not critique that model. Instead, it uses it to quantify the possible costs of morbidity and mortality due to Covid-19 as a starting point for further analysis and debate.

The five New Zealand authors developed the model using parameters drawn from the experience of the 1918 flu epidemic. Some have since made a major contribution to the papers addressing the Covid-19 crisis published by the Ministry of Health in the last fortnight.

Unfortunately, an updated version of the 2017 model does not appear to have been published. Nor do the recently released papers appear to express the potential morbidity and mortality implications of Covid-19 in terms comparable to costs.

This research note takes the 2017 spreadsheet model as given and modifies it only to measure the morbidity and mortality rates indicated for Covid-19 in the papers.

This is not to endorse the 2017 model. Its utility lies in its readily understandable framework for discussing and exploring the trade-off between health wellbeing and cost. Its transparency also allows other researchers to modify, refine and extend it as more becomes known about the virus. This exercise is to begin an exploration of trade-offs, not to provide an authoritative valuation.

With this critical caveat, the key finding from the adaption of the 2017 model is that spending 6.1% of annual GDP might be justified if it saved the 33,600 Covid-19 deaths epidemiologists advised the Ministry of Health could result were the pandemic left "substantially uncontrolled." Under the lower projection of 12,600 deaths, spending more than 3.7% of annual GDP could be excessive, even if success was assured.

The paper's conclusions list several weighty caveats to this finding.

[1] Matt Boyd, Michael Baker, Osman Mansoor, Giorgi KviZhinadze and Nick Wilson, "Protecting an island nation from extreme pandemic threats: Proof-of-concept around border closure as an intervention", PLcs One 12(6) e0178732, 2017.

Introduction

University of Auckland senior lecturer and epidemiologist Simon Thornley has questioned whether the health risks of coronavirus are great enough to justify the costs of closing the borders and the job and income losses from lockdown.[2]

The enormous scale of these choices means this important question is far from easy to answer, but some light can be thrown on the matter.[3]

The first step is to estimate the likely value of the lost income from preventive measures, compared to an alternative, such as the losses from doing nothing. The second is to find a yardstick to compare dollar income losses with degrees of lost or impaired lives.

Everyone knows such comparisons are controversial, but resources are scarce and choices must be made. Ten million dollars spent saving lives in the health sector is money that cannot be used to improve road safety. People and capital cannot be used in two places at once.

This research note looks at ball-park numbers for expressing projected deaths and the quality of life lost from illness in dollar terms using the 2017 model.[4]

That model was developed before the onset of Covid-19 to estimate the likely degree of health impairment and death of flus like the 1918 flu epidemic in respect of demographic incidence and severity. We can now plug information about the demographic incidence and severity of Covid-19 into this model.

It cannot be stressed enough that these results are highly conditional. This report is a contribution to public debate, nothing more. Hopefully, the public sector is building much better models to advise ministers.

Section 1 explains why placing mainstream dollar values on death and impairment of human life is essential for human health and wellbeing to be taken seriously.

Section 2 explains the 2017 model and the adjustments made for Covid-19.

Section 3 presents the results.

1. Background – what is a reasonable cost of reducing deaths and improving the health quality of life?

What is the value of human life? For a road engineer concerned only with safety, all roads would be flat, straight, separated, dual highways. Every mountain would be made into a plain, and every valley exalted. The same goes for engineers designing buildings to withstand the strongest conceivable earthquakes and aircraft that could ever crash.

The cost of perfect safety is unaffordable, so engineers are obliged to design to a lesser standard. Otherwise, no one will hire them. The project funders must trade-off safety against the cost by putting an implicit or explicit value on a statistical human life.

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[2] Simon Thornley, *Is this a sledgehammer to squash a flea*?, Stuff digital edition, 31 March 2020. An article by Dr John Lee in the UK newspaper, The Spectator, “How deadly is the coronavirus? It’s still far from clear, there is room for different interpretations of the data” 28 March 2020, also drew attention to what was not known.

[3] See for example, Martin Lally, “The costs and benefits of a COVID-19 Lockdown”, 23 March 2020. https://www.scribd.com/document/452947703/The-Costs-and-Benefits-of-a-Covid-Lockdown#from_embed

[4] Matt Boyd, Michael Baker, Osman Mansoor, Giorgi KviZhinadze and Nick Wilson, “Protecting and island nation from extreme pandemic threats: Proof-of-concept around border closure as an intervention”, PLcs One 12(6) e0178732, 2017.

Nor is perfect safety desirable. Everyone trades risk for pleasure when crossing the road, swimming in shark-filled water or when consuming dangerous substances. People do not seek risk-free lives because safety is not absolute.

However, consistency in safety costs is important. It is senseless to spend $1 million to reduce annual deaths by one person if society could save two lives a year by spending that $1 million on something else. Focusing on greater earthquake safety for buildings at the neglect of spending, say, on public health is to sacrifice human life. Again, scarce resources can only be spent once.

The value for a statistical human life currently used in New Zealand road design was about $4 million in 2019.[5] If engineers can design a safer road that costs less than this figure, it is worth doing, according to this metric.

A further refinement is that safety design is also about avoiding injury, not just death. Road accidents cause everything from minor injuries through to devastating permanent loss of quality of life. So do some illnesses.

Health experts globally have categorised degrees of health loss due to impairment according to the fraction of a life-year of perfect health lost (multiplied by the number of lost years). This measurement is called a QALY – quality-adjusted life year. A minor illness could be a 10% reduction in QALY if it lasts a couple of weeks. A devastating disablement might be a 90% reduction for the remaining years of the person's life. The internationally accepted assignment of degrees of impairment to fractions of QALY lost is somewhat crude and contentious, but it is better than nothing.

The next step is to put a dollar value on the loss of a single QALY. A commonly used measurement is the nominal gross domestic product per capita, but a better proxy is Statistics New Zealand's national disposable income per capita estimates. For New Zealand, this was $52,500 for the 2019 calendar year. The base version of the 2017 model used $45,000.

The New Zealand Treasury has also provided values for a lost QALY when forming judgements about the value of a QALY lost or saved as a result of some government action or inaction. The authors of the 2017 model used the Treasury's values.

[5] See https://www.transport.govt.nz/mot-resources/road-safety-resources/roadcrashstatistics/social-cost-of-road-crashes-and-injuries/report-overview/

2. The structure of the 2017 epidemiological model and its results.

a) The structure of the 2017 model

The epidemiological section of the 2017 model presents New Zealand demographics in five-year steps and assumes each group will be infected in the same proportion. In scenario A, that proportion Is 40%, while in scenario B it is 50%.

It then determines the numbers of each age group feeling sick enough to consult with a general practitioner (GP) by assuming the proportions are the same for each age group. In scenario A that constant proportion is 5.9%, while in scenario B it is 10%. (The proportion of those who are infected who see their GP is 0.59/0.4 = 14.8% for scenario A and 0.1/.5 = 20% for scenario B.)

The number hospitalised in each age group is its population multiplied by 3.3% for both scenarios. (The proportion of those infected who are hospitalised is .033/,04 = 8.3% for scenario A and .033/.5 = 6.6% for scenario B.)

Calculating the number of deaths in each age group takes two steps. First, it multiplies the total population by an assumed population death rate. It assumes an average population death rate of 0.33% for scenario A (14,882) and 3.3% for scenario B (148,822).[6]

Second, it assumes an age distribution for those total deaths that is specific to the 1918 virus. The incidence of deaths is double-peaked for both scenarios and highest for the 0-5 age group (9.3% of all deaths). It drops to 4.4% for the 10-15 age group after which it rises progressively to the second peak of 8.9% of all deaths for the 40-45 age group. Those over the age of 65 accounts for only 11% of all deaths.

To calculate the QALY losses due to non-fatal illness for each age group, the model assumes mild flu for those not badly infected enough to see a GP or be hospitalised, moderate flu for those seeing their GP and severe flu for those hospitalised. The QALY losses for these conditions are set at 0.0001, .0020 and .0121 respectively. Multiplying the number in each case by its unit QALY value and the modelled duration of the illness gives a total QALY loss of 2183 for scenario A and 2533 for scenario B.

At an assumed value per QALY of $45,000, the total impaired QALY value due to morbidity was $98 million for scenario A and $114 million for scenario B.

The costs of the deaths are given by the number of deaths in each age group multiplied by the number of health-adjusted life years lost valued at annual GDP per capita.[7] In the model, this value was highest for those aged 0-5 years at $1.28 million per death. The lowest value was $161,000 for anyone in the 85+ age group. Economists will note this methodology differs from that used to estimate the value of a statistical life in road safety design and is much lower.

Following this procedure, the statistical value of the remaining years of life lost due to death was $14.15 billion in scenario A and $146 billion in scenario B. In short, the cost of death outweighs all other health costs.

Adding in the cost to hospitals and GPs (about $3 billion) gave a total health cost of $17 billion in scenario A and $145 billion for scenario B. By comparison, last December Treasury expected GDP to

[6] The death rates for those infected and those hospitalised were 0.8% and 10% respectively for scenario A and 6.6% and 100% respectively for scenario B.

[7] The benchmark assumption is that the individual would have experienced the average life expectancy of his or her age cohort but for the premature death. The calculator and user guide for these “estimated maximum intervention rates” can be accessed here: https://www.otago.ac.nz/wellington/departments/publichealth/research/bode3/otago078632.html

be $319 billion in the year ended June 2020. The overall morbidity, mortality and health system costs represent 5% and 46% of annual GDP respectively.

b) Modifying the model to Covid-19 parameters.

The first necessary adjustment replaced the age distribution of deaths for the 1918 flu epidemic with one that considers that Covid-19 disproportionately kills the elderly.

Values for the age distribution for hospitalisation and deaths were taken from Table A3-2 in a February draft paper for the Ministry of Health.[8] With some interpolation, it showed those aged at least 65 years accounted for 35% of estimated 336,000 hospitalisations and 82% of deaths. In its "plan for" scenario, the number of hospitalisations was kept at 336,000 whether deaths were 33,600 or 12,600.

The next step was to align various other parameters with advice from New Zealand's leading epidemiologists to the Ministry of Health.

Specifically, a draft paper for the Ministry of Health dated 27 February 2020 provided the following guidance about relevant parameters:[9]

- 65% of the population (3.23 million) stood to be infected if the virus was "substantially uncontrolled;"
- 34% of the population (1.68 million) would be symptomatic.

The total 2014 population in the 2017 model was scaled up until 65% of the 3.23 million were infected which increased the value of a lost QALY was to $52,500 (national disposable income per capita for the latest available year).

3. Results

For the above parameters and 33,600 deaths, the QALY loss totalled 5901, with a monetised value of $310 million.[10] The statistical value of deaths was $12.2 billion. Healthcare costs (GPs and hospitals) added $6.9 billion.

The total health-related pandemic cost amounted to $19.4 billion, or 6.1% of GDP.

If deaths are reduced to 12,600, the statistical value of the deaths falls to $4.6 billion and the total health-related pandemic cost drops to $11.8 billion (3.7% of GDP).

Conclusions

The adapted model indicates spending 6.1% of GDP to save 33,600 deaths, or 3.7% of GDP to save 12,600 lives, is economically justifiable. To spend more begs the question of whether more lives could be saved over time if the money went instead to make safer roads and buildings, or perhaps spent on other health services.

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[8] Dr Lucy Telfar Barnard, Prof Nick Wilson, Dr Amada Kvalsvig, Prof Michael Baker, :Modelled Estimates for the spread and health impact of Covid-19 in New Zealand: Revised Preliminary Report for the Ministry of Health, 27 February 2020. See also, Nick Wilson, Michael Baker, "Potential age-specific health impacts from uncontrolled spread of the COVID-19 Pandemic on the New Zealand population using the CovidSIM model: Report to the Ministry of Health, 16 March 2020.

[9] Dr Lucy Telfar Barnard, Prof Nick Wilson, Dr Amada Kvalsvig, Prof Michael Baker, :Modelled Estimates for the spread and health impact of Covid-19 in New Zealand: Revised Preliminary Report for the Ministry of Health.

[10] This is using parameter values in scenario A of the 2017 except where otherwise stated.

This presumes spending 6% of GDP would achieve the hoped-for savings. It would not justify spending as much where there is only a modest chance of success.

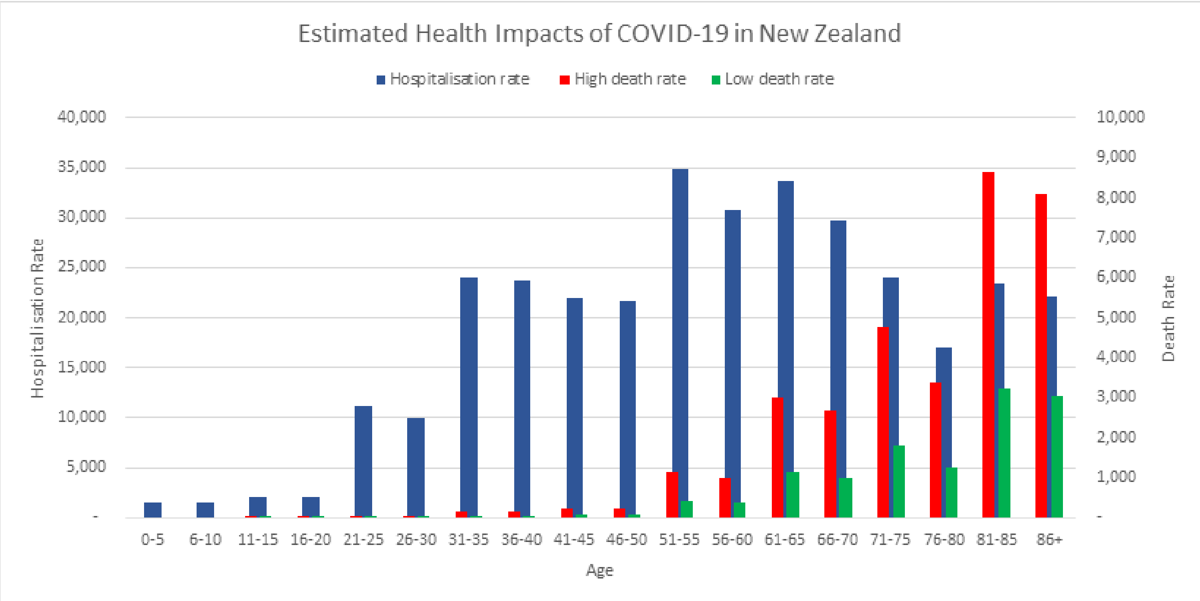
These findings are subject to many material qualifications, including:

- The estimated cost of the modelled "substantially uncontrolled' epidemic would be much greater if using the values for a statistical life in road design;
- The model does not include the value of lost production and thereby lost national income due to loss of production from morbidity and mortality;
- The degree to which the modelled deaths allow for excess deaths due to an overloaded hospital system is unclear;
- The 2017 values for years lost due to death were not updated[11];
- Most of the parameters have wide uncertainty bounds;
- The "plan for" scenario can be towards the "worse-case" end of the outcome spectrum."[12]

It would be useful if the Government released full details of the models used to generate the scenarios and estimates in the Ministry of Health papers if it has not already done so. This would obviate the need for those outside Government to undertake the exercise described in this note.

No one is comfortable about placing a price on death, but the trade-offs must be addressed if wellbeing is the objective.

Figure 1: This chart shows the modelled distribution of the contribution of each age group to the assume overall hospitalisation rates and death rates.



[11] A preliminary investigation of the calculator did not indicate that this would make much difference, but it was not clear if the values in the calculator had been updated.
[12] Telfar et al, op cit, 2.