APPENDIX 2: Impact Matrix

The Impact Matrix contains impact scores of 25 dominant health conditions in New Zealand (NZ) mapped to five health preference criteria: scale of disease, household financial effect, cost-effectiveness, health inequity, and multimorbidity. Impact scores were derived from a systematic review of reports from the NZ Ministry of Health, the World Health Organization (WHO), the NZ Treasury, and other published studies from NZ, Australia, the United Kingdom, Canada, and the United States.

Table 2A. Impact Matrix of 25 dominant health conditions in NZ: Impact scores were ranked from 1 to 5 (in order of lowest to highest impact/priority)

<table>
<thead>
<tr>
<th>Health Condition</th>
<th>Scale of disease</th>
<th>Household financial effect (HFE)</th>
<th>Cost-effectiveness (CE)</th>
<th>Health inequity</th>
<th>Multimorbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic heart disease</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Female breast cancer</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Trachea, bronchus, lung cancer</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Suicide</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Kidney, renal disease</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Lymphomas, multiple myeloma</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Mouth, oesophagus, and gastric cancer</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Premature birth</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Dementia</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Mental and behavioral disorders</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

1 DALY estimates from the WHO Global Health Estimates 2015 summary tables were used to estimate the morbidity and mortality impacts of the corresponding health conditions in NZ, unless otherwise mentioned [67].

2 Proportion of negative impact on average monthly earnings was derived from Dixon 2015, unless otherwise mentioned [58].

3 Maori/non-Maori and female/male mortality rate ratios were referenced from the latest NZ Ministry of Health mortality reports, unless otherwise mentioned [68,69].

4 Average multimorbidity burdens associated with each health condition were estimated using the M3 index from Stanley 2017, unless otherwise mentioned [70].
1. Ischaemic heart disease:
   - The CE score is based on PHARMAC, 2001 estimates for statins in NZ [1].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with heart failure [2].

2. Female breast cancer:
   - The CE score is based on BODE⁳ estimates for female breast cancer [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with female breast cancer [4].

3. Trachea, bronchus, lung cancer:
   - The HFE score is based on household financial costs associated with lung, bronchus, or trachea cancer, estimated by the University of Bristol, 2013 [5].
   - The CE score is based on BODE⁵ estimates for lung, trachea, and bronchus cancers [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with lung cancer [6].
4. Suicide:
   - Age-specific suicide rates in New Zealand in 2013 show that the median age at suicide was approximately 40 years. Assuming a median weekly income of 621 NZD, the foregone annual income per individual to suicide was estimated at 32,401 NZD.
   - The NZ Ministry of Health launched a national campaign at address the issue of suicide from multiple angles of prevention [7]. The CE score here is based on the higher end of very cost-effective interventions for individuals in Australia who make non-fatal suicide attempts [8].
   - The health inequity score of suicide by ethnicity and gender was based on estimates from the NZ Ministry of Health [9].
   - The multimorbidity score for suicide attempters was based on estimates of comorbid mental conditions such as severe anxiety, depression, and substance disorders [10].

5. Kidney, renal disease:
   - The HFE score is based on productivity/income losses associated with changes in employment for predialysis and dialysis patients in NZ and end-stage renal patients in Canada [11,12].
   - The CE score is based on a systematic review of economic evaluations of haemodialysis for people with end-stage renal failure [13].
   - The health inequity score of kidney disease and renal failure by ethnicity and gender was based on estimates from the NZ and Australia [14,15].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with chronic kidney disease in the United States [16].

6. Lymphomas, multiple myeloma:
   - The HFE score is based on household financial costs associated with lymphoma, leukaemia, or myeloma, estimated by the University of Bristol, 2013 [5].
   - The CE score is based on BODE³ estimates for Hodgkin’s lymphoma, non-Hodgkin’s lymphoma, and myeloma [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with non-Hodgkin lymphoma in the United States [17].
7. Diabetes:
   - The CE score is based on PHARMAC, 2005 estimates for insulin analogues in NZ [18].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with diabetes in the United States [19].

8. Mouth, oesophagus, and gastric cancer:
   - The HFE score is based on household financial costs associated with oesophagus, stomach, pancreas, or liver cancers estimated by the University of Bristol, 2013 [5].
   - The CE score is based on average BODE³ estimates for lip, mouth, pharynx, oesophageal, and stomach cancers [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with gastric cancer in the United States [20].

9. Premature birth:
   - The HFE score is estimated from socioeconomic attainments for individuals in the Helsinki Birth Cohort Study who were born late-preterm (34-36 weeks) and were 34% more likely to earn in the lowest tercile range [21]. To compute the corresponding HFE of preterm birth in NZ, we assumed uniform distribution within each quintile bin of NZ earnings [22]. Weekly personal income ranges for each tercile were calculated using piecewise linear models of the relevant quintiles. For example, to estimate the income range of the lowest tercile (33%), we calculated the slope and y-intercept of income for individuals in the second quintile (21% - 40%). These parameters were then used to estimate the upper bound of the income range for individuals in the 33rd percentile, from which the average HFE score for premature birth was calculated.
   - The CE score for regular midwifery visits/staffing is based on NICE estimates from the United Kingdom [23].
   - The multimorbidity score for premature birth was based on prevalence estimates for various medical disabilities at birth in Norway [24].

10. Dementia:
    - The scale of impact score was from the Alzheimers New Zealand 2016 report [25].
    - The HFE score was computed from productivity losses, reduced employment, and absenteeism estimates in NZ associated with dementia [25].
    - The CE score is based on dementia screening tests in primary care in the United Kingdom [26].
The health inequity score of dementia by ethnicity and gender was based on estimates from the Alzheimers New Zealand 2016 report [25]. The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with dementia in Spain [27].

11. Mental and behavioral disorders:
- The HFE score was computed from productivity losses, reduced employment, and absenteeism estimates associated with mental/behavioral disorders [28,29]. To estimate the impact of various mental health conditions on work/school and social/family life, the World Health Organization World Mental Health Survey Initiative version of the Composite International Diagnostic Interview (CIDI 3.0) was conducted among 12,992 respondents in New Zealand. Respondents reported mild-moderate effects of anxiety disorders on work/school functioning and moderate-marked effects of mood disorders on work/school functioning. To quantify the indirect costs of mental health conditions in New Zealand, we used the OECD 2014 mental health report that estimated a 16.7% higher absenteeism rate for individuals with moderate disorders compared to individuals with no mental health disorder from among 21 European OECD countries in 2010. Assuming this higher rate for individuals with mental health conditions (4.8 days vs. 4.1 days), and assuming that 45% of all lost working days were due to mental illness (2.2 days), this translates to a 1% negative impact on average annual earnings.
- The CE score for mental/behavioral disorders is based on screenings/interventions for individuals in Australia [30].
- The health inequity score by ethnicity and gender for common mental/behavioral disorders was based on NZ Ministry of Health statistics. In the 2014, the New Zealand Mental Health foundation released a report that women were 1.6 times more likely receive a diagnosis of a common mental health condition compared to men (20% vs. 13%) [31]. According to the Office of the Director of Mental Health Annual Report (2015), Maori individuals account for 26% of all mental health service users even though they make up only approximately 16% of the New Zealand population [32]. On average, Maori were 3.5 times more likely than non-Maori to be subject to compulsory treatment orders. While the over-representation of Maori in compulsory treatment is a complex issue pertaining to cultural biases, disproportionately harsh treatment of Maori with mental health conditions, and lack of Maori family/community involvement in mental health treatment, we are using these rates as a proxy to demonstrate the higher burden of mental health conditions among Maori.
- The M3 multimorbidity score was calculated using the average M3 of anxiety/behavioral disorders and major psychiatric disorders from Stanley 2017 combined with physical comorbidity prevalence estimates associated with anxiety disorders [33].
12. Leukaemia:
   - The HFE score is based on household financial costs associated with lymphoma, leukaemia, or myeloma, estimated by the University of Bristol, 2013 [5].
   - The CE score is based on BODE³ estimates for leukaemia [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with acute myeloid leukaemia in Germany [34].

13. COPD:
   - The CE score for COPD is based on long-term air humidification therapy estimates in NZ [35].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with COPD in the United States and Spain [36].

14. Cervical cancer:
   - The HFE score is based on household financial costs associated with cervical, ovarian, or uterine cancers estimated by the University of Bristol, 2013 [5].
   - The CE score is based on BODE³ estimates for cervical cancer [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with cervical cancer in Italy [37].

15. Cerebrovascular disease:
   - The CE score for cerebrovascular disease is based on cost-effectiveness of acute stroke units in NZ [38].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with cerebrovascular disease in Turkey [39].

16. Prostate cancer:
   - The CE score is based on BODE³ estimates for prostate cancer [3].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with prostate cancer in the United States [40].
17. Colorectal cancer:
- The HFE score is based on household financial costs associated with colorectal cancer estimated by the University of Bristol, 2013 [5].
- The CE score is based on BODE³ estimates for colorectal cancer [3].
- The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with colorectal cancer in the Netherlands [41].

18. Pancreatic cancer:
- The HFE score is based on household financial costs associated with oesophagus, stomach, pancreas, or liver cancers estimated by the University of Bristol, 2013 [5].
- The CE score is based on BODE³ estimates for pancreatic cancer [3].
- The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with pancreatic cancer in Denmark [42].

19. Asthma:
- The HFE score is based on direct household financial costs associated with asthma in NZ [43].
- The CE score for chronic asthma is based on cost-effectiveness of salmeterol xinafoate/fluticasone propionate combination inhalers in the United Kingdom [44].
- The health inequity score of asthma by ethnicity and gender was based on estimates from the NZ Ministry of Health [45].
- The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with asthma [46].

20. Hypertensive disease:
- Obesity in NZ is a primary risk factor for hypertension [47]. While the economic effect of hypertension on worker productivity/income has not been quantified in New Zealand, lost productivity for overweight and obesity in both New Zealand and Australia has been documented [48]. According to the Australian Statistics Bureau in 2004-05, employees who were overweight/obese had absenteeism rates that were 14.3% higher than employees who were underweight or normal weight [49]. We used the Moodie et al. findings and the New Zealand Treasury 2010 report to estimate that the average absenteeism rate for overweight/obese employees was 0.5 days more than the average absenteeism rate for underweight/normal weight employees in New Zealand (4.6 days vs. 4.1 days) [48,50]. Assuming an average 8-hour work day and 2,087 average work hours per year, this translates to a 0.2% negative impact on average annual income [51].
• The CE score is based on PHARMAC estimates for pulmonary arterial hypertension interventions in NZ [1].
• The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with hypertension in Denmark [52].

21. HIV/AIDS:
• The HFE score is based on direct household financial impacts associated with HIV/AIDS in NZ [53].
• The CE score is based on PHARMAC estimates for HAART in NZ [1].
• The health inequity score of HIV/AIDS by ethnicity and gender was based on estimates from the NZ AIDS Foundation [54].
• The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with HIV/AIDS in the United Kingdom [55].

22. Melanoma of skin:
• The CE score is based on BODE³ estimates for melanoma [3].
• The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with melanoma in the United States [56].

23. Gestational diabetes:
• DALYs for all maternal conditions in NZ was used as a proxy for DALYs for gestational diabetes.
• According to the National Institutes of Health in the United States, women with a history of gestational diabetes (GDM) have up to a 60% chance of developing diabetes in the next 1-2 decades of life [57]. Therefore, we used the impact of diabetes on average monthly earnings (5.4% negative impact) as a proxy for the impact of gestational diabetes on average monthly earnings [58].
• The CE score for regular midwifery visits/staffing is based on NICE estimates from the United Kingdom [23].
• The health inequity score of gestational diabetes by ethnicity was based on estimates from the NZ Ministry of Health [59].
• The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with diabetes in the United States [19].
24. Motor vehicle accidents:
   - The CE score is based on road injury prevention measures in Europe [60].
   - The M3 multimorbidity score was calculated using average multimorbidity prevalence estimates associated with traumatic brain injury in the United States and Finland [61,62].

25. Peptic ulcer disease:
   - The HFE score is based on work loss due to peptic ulcer disease in the United States [63].
   - The CE score for peptic ulcer disease based on a model of *H. pylori* screening in NZ [64].
   - The health inequity score of peptic ulcer disease was based on proxy of the incidence of upper gastrointestinal haemorrhage by ethnicity in NZ and by gender in Denmark [65,66].
Table 3A. Relative importance of health conditions using normalized preference weights (Non-Māori respondents vs. Māori respondents)

<table>
<thead>
<tr>
<th>Non-Māori respondents</th>
<th>Māori respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health condition</strong></td>
<td><strong>Score</strong></td>
</tr>
<tr>
<td>1 Ischaemic heart disease</td>
<td>4.20</td>
</tr>
<tr>
<td>2 Female breast cancer</td>
<td>3.84</td>
</tr>
<tr>
<td>3 Trachea, bronchus, lung cancer</td>
<td>3.77</td>
</tr>
<tr>
<td>4 Suicide</td>
<td>3.71</td>
</tr>
<tr>
<td>5 Kidney disease, renal failure</td>
<td>3.58</td>
</tr>
<tr>
<td>6 Lymphomas, multiple myeloma</td>
<td>3.41</td>
</tr>
<tr>
<td>7 Diabetes</td>
<td>3.35</td>
</tr>
<tr>
<td>8 Mouth, oesophagus, and gastric cancer</td>
<td>3.33</td>
</tr>
<tr>
<td>9 Premature birth</td>
<td>3.28</td>
</tr>
<tr>
<td>10 Dementia</td>
<td>3.25</td>
</tr>
<tr>
<td>11 Mental and behavioral disorders</td>
<td>3.23</td>
</tr>
<tr>
<td>12 Leukaemia</td>
<td>3.23</td>
</tr>
<tr>
<td>13 COPD</td>
<td>3.18</td>
</tr>
<tr>
<td>14 Cervical cancer</td>
<td>3.15</td>
</tr>
<tr>
<td>15 Cerebrovascular disease</td>
<td>3.11</td>
</tr>
<tr>
<td>16 Prostate cancer</td>
<td>3.08</td>
</tr>
<tr>
<td>17 Colorectal cancer</td>
<td>3.00</td>
</tr>
<tr>
<td>18 Pancreatic cancer</td>
<td>2.85</td>
</tr>
<tr>
<td>19 Asthma</td>
<td>2.79</td>
</tr>
<tr>
<td>20 Hypertensive disease</td>
<td>2.61</td>
</tr>
<tr>
<td>21 HIV/AIDS</td>
<td>2.60</td>
</tr>
<tr>
<td>22 Melanoma of skin</td>
<td>2.53</td>
</tr>
<tr>
<td>23 Gestational diabetes</td>
<td>2.39</td>
</tr>
<tr>
<td>24 Motor vehicle accidents</td>
<td>2.36</td>
</tr>
<tr>
<td>25 Peptic ulcer disease</td>
<td>1.89</td>
</tr>
</tbody>
</table>
References:


58. Dixon S. The Employment and Income Effects of Eight Chronic and Acute Health Conditions [Internet]. 2015. Available from:


70. Stanley J, Sarfati D, Chb MB. The new Measuring Multimorbidity index predicted mortality better than Charlson and Elixhauser indices amongst the general population. J Clin Epidemiol [Internet]. 2017; Available from: http://dx.doi.org/10.1016/j.jclinepi.2017.08.005