The Global Burden of Disease Study 2010 (GBD 2010)

• Led by University of Washington (principal investigator Chris Murray)

• Estimated health loss (burden) globally and for 187 countries (including NZ)

• NZBD independent but designed to be compatible (same standards and methods)

• So why do our own study?
  – Access to much more empirical data for NZ (less dependent on modelling)
  – Validation

• Advantages of having both GBD country estimate for NZ and NZBD:
  – Greater credibility
  – Ownership
  – Can use GBD for international benchmarking (provided good concordance)
  – Can use GBD historical trends to improve projections (provided good concordance)
Objectives of the NZBDS 2006-2016

• Generate an *internally consistent* set of epidemiological estimates for a *comprehensive* set of 220 diseases and injuries in 18 condition groups and 31 risk factors in 10 risk factor clusters

• [Epidemiological estimates = incidence, prevalence, severity distribution, survival and mortality for each condition – all by 20 age groups, both sexes, and Maori – nonMaori ethnic groups]

• Using this database, estimate the burden of disease and injury (i.e. *health loss*, in DALYs) and summarise this information in terms of *health expectancy* (HALE)
BD concepts

– **Years of life lost (YLLs)** for a cause is the number of deaths from the cause at age $x$ multiplied by the standard life expectancy at age $x$.

– **Years lived with disability (YLDs)** for a cause in an age-sex group is the prevalence of each sequela of that cause multiplied by the disability weight for that sequela, summed across all sequelae.

– **Sequela** or health state is any stage, phase or complication of disease or injury.

– **Disability weights** are assessments of relative severity of different health states, on a $0 – 1$ scale. ‘Severity’ or ‘disability’ refers to any short-term or long-term nonfatal health loss (impairment, functional limitation, dysphoric affective state or symptom).

– **Disability adjusted life-years (DALYs)** for a cause in an age-sex group is the sum of YLLs and YLDs for that cause. So $1$ DALY = $1$ year of healthy life lost.

– **Health expectancy (HALE)** is a generalisation of life expectancy to incorporate time lived in different health states (operationalised as all-cause YLD rate).
New Zealand Health Tracker

- PHO
- NNPAC
- Mortality
- NMDS
- NHI
- Cancer
- Pharms & Labs
- MHINC

Tracker
New Zealand Health Tracker: Indicators

• Prevalence (example: Gout)
  
  • EITHER received a discharge diagnosis of gout (ICD9 274 or ICD10 M10) from a public hospital any time from 1988 to 2009
  
  • OR been dispensed allopurinol or colchicine from a community pharmacy any time from 2001 to 2009 AND did not have a diagnosis of a haematological malignancy in the 24 months preceding the first dispensing of allopurinol
  
  • AND were alive and still living in NZ as at last quarter 2009 as evidenced by any recorded health care contact during 2008-9 (including being enrolled in a PHO)

• Incidence
  
  • Similar to prevalence
  
  • Main difference is need to accurately identify first ever events
  
  • Retrograde survival model used to derive correction factor for over-ascertainment of first-ever events according to the number of years of linked data on which estimate is based
Example: Coronary heart disease (CHD)

- People with CHD
- People diagnosed with CHD
  - People with a CHD hospital diagnosis
  - Medications and hospitalisations
  - People taking anti-anginal medications
New Zealanders sustained health losses totalling almost one million DALYs in 2006

- Male : Female age standardised DALY rate ratio 1.14
- Maori : non-Maori age standardised DALY rate ratio 1.76

955,000 DALYs

486,000 YLLs

469,000 YLDs
All-cause DALY age pyramid
Maori experience relatively larger and earlier health losses.
Seven condition groups account for three quarters of all health lost

- Cancer
- Cardiovascular
- Mental
- Musculoskeletal
- Injury
- Neurological
- Respiratory
- Endocrine
- Reproductive
- Disorders of infancy
- Gastrointestinal
- Infections
- Urogenital
- Skin
- Birth defects
- Dental
- Vision & hearing
- Blood
Alternative classification: body system

Neuropsychiatric Disorders
Vascular and Blood Disorders
Respiratory Disorders
Gastrointestinal Disorders
Musculoskeletal Disorders
Reproductive and Gestational Disorders
Infant Disorders
Endocrine Disorders
Genitourinary Disorders
Skin Disorders
Sense Organ Disorders
Oral Disorders

DALYs
Trends in the cardiovascular burden

% all cause DALYs

- CVD GBD
- CVD NZBD

Year

Trends in the cancer and cardiovascular burdens
Twenty five specific causes each account for >1% DALYs

<table>
<thead>
<tr>
<th>Rank</th>
<th>Specific Conditions</th>
<th>DALYs</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coronary disease</td>
<td>89,159</td>
<td>9.3%</td>
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<tr>
<td>2</td>
<td>Anxiety / depression</td>
<td>50,954</td>
<td>5.3%</td>
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<tr>
<td>3</td>
<td>Stroke</td>
<td>37,688</td>
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<tr>
<td>4</td>
<td>COPD</td>
<td>35,339</td>
<td>3.7%</td>
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<tr>
<td>5</td>
<td>Diabetes</td>
<td>28,808</td>
<td>3.0%</td>
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<tr>
<td>6</td>
<td>Lung cancer</td>
<td>28,570</td>
<td>3.0%</td>
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<td>7</td>
<td>Back disorders</td>
<td>27,112</td>
<td>2.8%</td>
</tr>
<tr>
<td>8</td>
<td>Bowel cancer</td>
<td>24,012</td>
<td>2.5%</td>
</tr>
<tr>
<td>9</td>
<td>Traumatic brain injury</td>
<td>21,728</td>
<td>2.3%</td>
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<tr>
<td>10</td>
<td>Osteoarthritis</td>
<td>20,738</td>
<td>2.2%</td>
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<tr>
<td>11</td>
<td>Alcohol use disorder</td>
<td>19,706</td>
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<tr>
<td>12</td>
<td>Breast cancer</td>
<td>17,870</td>
<td>1.9%</td>
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<td>13</td>
<td>Dementia</td>
<td>16,949</td>
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<tr>
<td>14</td>
<td>Asthma</td>
<td>15,084</td>
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<td>15</td>
<td>Migraine</td>
<td>13,094</td>
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<td>16</td>
<td>Insomnia</td>
<td>12,772</td>
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<td>17</td>
<td>Schizophrenia</td>
<td>12,328</td>
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<td>18</td>
<td>Chronic pain syndromes</td>
<td>12,202</td>
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<tr>
<td>19</td>
<td>Premature birth</td>
<td>11,640</td>
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<tr>
<td>20</td>
<td>Internal injury</td>
<td>11,572</td>
<td>1.2%</td>
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<tr>
<td>21</td>
<td>Rheumatoid arthritis</td>
<td>10,320</td>
<td>1.1%</td>
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<tr>
<td>22</td>
<td>Poisoning (toxic injury)</td>
<td>10,197</td>
<td>1.1%</td>
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<tr>
<td>23</td>
<td>Prostate cancer</td>
<td>9,786</td>
<td>1.0%</td>
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<tr>
<td>24</td>
<td>Eczema / dermatitis</td>
<td>9,479</td>
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<tr>
<td>25</td>
<td>Menstrual disorders</td>
<td>9,362</td>
<td>1.0%</td>
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</tbody>
</table>
Comparative rankings: specific causes by ethnicity

- Relatively high burden in Māori
  - SUDI
  - Cardiomyopathy
  - Bipolar disorder
  - Stomach cancer
  - Stillbirth

- Relative high burden in Non-Māori
  - Chronic pain
  - Rheumatoid arthritis
  - Osteoarthritis
  - Bowel cancer
  - Prostate cancer
  - Dementia
Some specific causes are very unequally distributed, but don’t necessarily contribute much to inequality.
Some diseases are risk factors for other diseases

- Anxiety/Depression: 5.3% Direct, 1.5% Indirect
- Diabetes and pre-diabetes: 3.0% Direct, 1.7% Indirect
- Schizophrenia: 1.3% Direct, 0.4% Indirect
- Chronic Kidney disease: 0.8% Direct, 0.4% Indirect
- Atrial Fibrillation: 0.5% Direct, 0.4% Indirect
- Obstructive sleep apnea disorders: 0.3% Direct, 0.2% Indirect
Risks to health: risk factor clusters
Risks to health: specific risk factors

- Tobacco use
- High body mass index
- High blood pressure
- High blood glucose
- Physical inactivity
- Alcohol
- High blood cholesterol
- Adverse health care events
- High sodium intake
- Illicit drug use
- High saturated fat intake
- Low vegetable and fruit intake
- Unsafe sex
- Low bone mineral density

Percent DALYs from all causes

- Vascular
- Diabetes
- Cancers
- Osteoarthritis
- Other
Trends in the tobacco burden

% all cause DALYs

- Tobacco GBD
- Tobacco NZBD

Year

Trends in the Tobacco and BMI burdens

Attributable burden as a percentage of total DALYs

Tobacco-attributable burden

BMI-attributable burden

Year

Risks for injury

Percentage of total injury DALYs attributable to selected external causes, NZ 2006

- Self inflicted
- Road traffic crashes
- Falls
- Interpersonal violence
- Mechanical force
- Drowning
- Poisoning
- Fire
- Animals
- Mental*
- Alcohol*
- Illicit drugs*
## Injury matrix, 2006

<table>
<thead>
<tr>
<th>Category</th>
<th>TBI</th>
<th>Other Injury</th>
<th>Internal</th>
<th>Toxic effects</th>
<th>Immersion</th>
<th>Fracture &amp; disloc</th>
<th>Open wound</th>
<th>Burn</th>
<th>Amputation</th>
<th>Total</th>
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<tr>
<td>Transportation</td>
<td>15097</td>
<td>308</td>
<td>7936</td>
<td>136</td>
<td>571</td>
<td>488</td>
<td>197</td>
<td>169</td>
<td>57</td>
<td>24959</td>
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<tr>
<td>Falls</td>
<td>4092</td>
<td>243</td>
<td>803</td>
<td>6</td>
<td>11</td>
<td>2295</td>
<td>199</td>
<td>17</td>
<td>8</td>
<td>7673</td>
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<tr>
<td>Fire</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>355</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1000</td>
<td>1</td>
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<td>Drowning</td>
<td>74</td>
<td>16</td>
<td>33</td>
<td>16</td>
<td>3287</td>
<td>7</td>
<td>0</td>
<td>0</td>
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<td>Poisoning</td>
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<td>0</td>
<td>2591</td>
<td>4</td>
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<td>0</td>
<td>63</td>
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<td>Animal related</td>
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<td>26</td>
<td>85</td>
<td>28</td>
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<td>37</td>
<td>13</td>
<td>0</td>
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<td>Mechanical force</td>
<td>1035</td>
<td>916</td>
<td>494</td>
<td>0</td>
<td>12</td>
<td>173</td>
<td>219</td>
<td>95</td>
<td>623</td>
<td>3567</td>
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<td>Other unintentional</td>
<td>304</td>
<td>1861</td>
<td>215</td>
<td>50</td>
<td>79</td>
<td>129</td>
<td>32</td>
<td>31</td>
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<td>2707</td>
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<td>Self-inflicted</td>
<td>1902</td>
<td>13854</td>
<td>1447</td>
<td>6660</td>
<td>500</td>
<td>143</td>
<td>402</td>
<td>195</td>
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<td>Interpersonal violence</td>
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<td>404</td>
<td>890</td>
<td>51</td>
<td>85</td>
<td>323</td>
<td>642</td>
<td>61</td>
<td>7</td>
<td>4486</td>
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<tr>
<td>Total</td>
<td>24642</td>
<td>17640</td>
<td>11904</td>
<td>9893</td>
<td>4548</td>
<td>3601</td>
<td>1703</td>
<td>1632</td>
<td>704</td>
<td>76267</td>
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## Health expectancy estimates and projections

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<th>Year</th>
<th>LEo</th>
<th>HEo</th>
<th>Difference</th>
<th>Ratio</th>
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<tr>
<td><strong>2006</strong></td>
<td></td>
<td></td>
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<tr>
<td>Māori males</td>
<td>70.4</td>
<td>60.1</td>
<td>10.3</td>
<td>0.85</td>
</tr>
<tr>
<td>Māori females</td>
<td>75</td>
<td>62.8</td>
<td>12.2</td>
<td>0.84</td>
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<tr>
<td>Non-Māori males</td>
<td>78.9</td>
<td>69.9</td>
<td>9</td>
<td>0.89</td>
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<tr>
<td>Non-Māori females</td>
<td>82.8</td>
<td>71.4</td>
<td>11.4</td>
<td>0.86</td>
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<tr>
<td><strong>2011</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Māori males</td>
<td>73.3</td>
<td>62.6</td>
<td>10.7</td>
<td>0.85</td>
</tr>
<tr>
<td>Māori females</td>
<td>77.6</td>
<td>64.5</td>
<td>13.1</td>
<td>0.83</td>
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<tr>
<td>Non-Māori males</td>
<td>79.9</td>
<td>70.8</td>
<td>9.1</td>
<td>0.89</td>
</tr>
<tr>
<td>Non-Māori females</td>
<td>84.4</td>
<td>72.4</td>
<td>12</td>
<td>0.86</td>
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<tr>
<td><strong>2016</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Māori males</td>
<td>74.9</td>
<td>64</td>
<td>10.9</td>
<td>0.85</td>
</tr>
<tr>
<td>Māori females</td>
<td>78.1</td>
<td>65.7</td>
<td>12.4</td>
<td>0.84</td>
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<tr>
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<td>80.6</td>
<td>71.2</td>
<td>9.4</td>
<td>0.88</td>
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<tr>
<td>Non-Māori females</td>
<td>84.9</td>
<td>72.8</td>
<td>12.1</td>
<td>0.86</td>
</tr>
</tbody>
</table>
Compression or expansion of morbidity?

1990
2010

Healthy Years Lost to Disability vs. Life Expectancy
Comparison of NZBD 2006 with GBD 2010 Australasian region and New Zealand country estimates

• Very good agreement at all-cause level (especially YLL)

• Good agreement at specific condition / risk factor level, with some exceptions

• Exceptions: some musculoskeletal disorders, especially back disorders and osteoarthritis; alcohol use disorder; falls YLDs only; vegetables & fruit; some minor conditions and risk factors

• Best agreement for cancers (YLL dominated; single excellent data source; clear case definitions and disease schematics)

• Worst agreement for musculoskeletal disorders (YLD dominated; multiple poor quality data sources; unclear case definitions and severity distributions)
### GBD 2010 – NZBD 2006 comparison: conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>GBD 2010 Australasian region</th>
<th>GBD 2010 New Zealand</th>
<th>NZBD 2006</th>
<th>%</th>
<th>rank</th>
</tr>
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<tbody>
<tr>
<td>Coronary heart disease</td>
<td>7.9</td>
<td>8.3</td>
<td>9.3</td>
<td>2</td>
<td>1</td>
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<td>Anxiety and depressive disorders</td>
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<td>5.5</td>
<td>5.3</td>
<td>3</td>
<td>2</td>
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<td>Stroke</td>
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<td>3.0</td>
<td>3.9</td>
<td>5</td>
<td>3</td>
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<td>COPD</td>
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<td>3.8</td>
<td>3.7</td>
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<td>Diabetes</td>
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<td>2.3</td>
<td>3.0</td>
<td>7</td>
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<td>Lung cancer</td>
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<td>2.8</td>
<td>2.9</td>
<td>6</td>
<td>6</td>
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<td>Back disorders</td>
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<td>7.0</td>
<td>2.8</td>
<td>3</td>
<td>7</td>
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<tr>
<td>Bowel cancer</td>
<td>2.1</td>
<td>2.4</td>
<td>2.5</td>
<td>10</td>
<td>8</td>
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<tr>
<td>Osteoarthritis</td>
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<td>1.0</td>
<td>2.2</td>
<td>15</td>
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<td>Alcohol use disorder</td>
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<td>1.1</td>
<td>2.0</td>
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<td>Breast cancer</td>
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<td>1.6</td>
<td>1.9</td>
<td>12</td>
<td>11</td>
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<tr>
<td>Dementia</td>
<td>2.3</td>
<td>2.2</td>
<td>1.8</td>
<td>9</td>
<td>12</td>
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<tr>
<td>Asthma</td>
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<td>2.2</td>
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<td>13</td>
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<td>Migraine</td>
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<td>1.5</td>
<td>1.4</td>
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<td>14</td>
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<tr>
<td>Schizophrenia</td>
<td>1.1</td>
<td>1.1</td>
<td>1.3</td>
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<td>15</td>
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<td>Premature birth complications</td>
<td>0.8</td>
<td>1.0</td>
<td>1.2</td>
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<td>Rheumatoid arthritis</td>
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<td>0.7</td>
<td>1.1</td>
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<td>Prostate cancer</td>
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<td>0.9</td>
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<td>Eczema and dermatitis</td>
<td>0.6</td>
<td>0.6</td>
<td>1.0</td>
<td>19</td>
<td>19</td>
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</tbody>
</table>
Comparative rankings: GBD 2010 country vs NZBD 2006, leading specific causes
GBD 2010 – NZBD 2006 comparison: risk factors

The chart shows the percent all-cause DALYs for various risk factors compared between NZBD 2006 and GBD NZ 2010. The risk factors are ordered from highest to lowest DALYs.

- Tobacco use
- High body mass index
- High blood pressure
- High blood glucose
- Low physical activity
- Alcohol use
- High blood cholesterol
- High sodium intake
- Low vegetable and fruit intake
- Illicit drug use
- High saturated fat intake
- Low bone mineral density

Legend:
- NZBD 2006
- GBD NZ 2010
Summary of key NZBD findings

• Two major transitions are currently in progress:
  – Cancer has overtaken cardiovascular disease as the leading cause of health loss at disease level
  – Obesity (raised BMI) is currently overtaking tobacco use as the leading cause of health loss at risk factor level.

• Poor diet is a leading cause of disease burden, particularly excess energy intake relative to expenditure, low consumption of fruits and vegetables, excessive saturated fat intake relative to unsaturated, and excessive sodium intake.

• Disabling conditions are making an increasing contribution to health loss: mental illness, musculoskeletal disorders (especially back disorders and osteoarthritis), sleep disorders, chronic pain syndromes, reproductive disorders, neurological disorders (especially dementia).

• Further expansion of morbidity (as measured by LE – HALE) is likely, unless health system can be re-focused on disabling disorders.
Possible policy uses of health loss data

- Health needs analysis
- Health impact analysis
- Health gap analysis
- Program budgeting
- Priority setting and resource allocation (input to cost effectiveness analysis - PBMA)
- Needs adjustment in population based funding formulae
- Health and health expenditure projection (MTEF)
- Health system performance assessment
- International benchmarking
- Monitoring compression vs expansion of morbidity (relevant for retirement / pensions policy, insurance industry, labour market policy)
- Beyond health system: Quality adjustment of GDP; labour markets; pensions /retirement; MSD
Acknowledgements

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• Project advisory group (especially Tony Blakely and Nick Wilson)
• Clinical advisors
• GBD 2010 team (especially Theo Vos, Majid Ezzati, Stephen Lim and Chris Murray)