Trends in all cause mortality, New Zealand

Rate per 100,000

Year

1970 to 2006

65-74 yrs
75-84 yrs
85+ yrs
How can deaths in old age be avoided?

Incidence reduction ("preventable" mortality)

Suscept → Prevalent cases → Dead

Case fatality reduction ("amenable" mortality)
Preventable mortality: concept

\[ PAF = 1 - \prod_{i=1}^{n} (1 - PAF_i) \]

\[ PIF = \frac{\int_{x=0}^{m} RR(x)P(x) - \int_{x=0}^{m} RR(x)P'(x)}{\int_{x=0}^{m} RR(x)P(x)} \]
Preventable mortality: attributable versus preventable mortality

- Attributable mortality:
  \[ \text{PAF (TMD)} \times \text{current total mortality} \]

- Preventable mortality:
  \[ \text{PAF (EPID)} \times \text{projected total mortality} \]
Preventable mortality: data requirements

- Population risk factor distribution (prevalence)
- Counterfactual risk factor distribution (TMD, EPID)
- Hazard function (for all cause or by cause mortality)
- Total all cause or by cause mortality (in age group) (current and projected)
Preventable mortality: hazard functions

**Blood pressure**
115 mmHg systolic

**Cholesterol**
3.8 mmol/l

**Body mass index**
21 kg/m²

**Risk of coronary disease**

- **Systolic blood pressure (mmHg)**
- **Total cholesterol (mmol/l)**
- **Body mass index (kg/m²)**
Preventable mortality: Why are RRs lower in older than younger adults?

![Graph showing RR = 2.0 for Young and RR = 1.2 for Old]

- Young: Smoker RR = 2.0, Nonsmoker RR = 1.2
- Old: Smoker RR = 600, Nonsmoker RR = 400
### Preventable mortality: mortality attributable to cardiovascular risk factors in New Zealand

<table>
<thead>
<tr>
<th>SBP</th>
<th>Attributable fraction</th>
<th>Avoidable fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65-74</td>
<td>75+</td>
</tr>
<tr>
<td>Coronary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>49%</td>
<td>29%</td>
</tr>
<tr>
<td>female</td>
<td>54%</td>
<td>35%</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>48%</td>
<td>42%</td>
</tr>
<tr>
<td>female</td>
<td>53%</td>
<td>50%</td>
</tr>
</tbody>
</table>

- **TMD for SBP = 115 mmHg ± 6 mmHg**
- **Attributable fraction for 2006**
- **Avoidable fraction for 2011**
- **Lag = 5 years (2 for risk reversal, 3 for implementation of intervention)**
- **EPID = 16% shift towards TMD (corresponds to a mean decrease of 0.5 mmHg in young adults but 2-3 mmHg in older people)**
Amenable mortality: concept

- Deaths that should not have occurred given available health care interventions

- “Untimely and unnecessary deaths, whose occurrence is a warning signal, a sentinel health event, [indicating] that the quality of care might need to be improved”

- “Deaths from those conditions for which variation in mortality rates (over time or across populations) reflects variation in effective coverage of health care”
The ‘Amenable Mortality’ construct: conceptual clarification

- Expert panel
- Selection criteria
- Cross mapping of widely used current lists
- Filtering of consolidated candidate conditions using selection criteria
- Review of draft list by expert panel
Amenable mortality construct: setting the boundary of the health system

- Health system cannot be held accountable for actions of other social systems

- Useful to distinguish preventable from amenable mortality

- So narrow boundary appropriate – health care system only

- Intersectoral or population-level interventions not eligible
Amenable mortality construct: explicit identification of intervention

- Amenability is a property of a condition – intervention pair, not of a condition per se

- Necessary to explicitly identify the ‘key’ intervention for each candidate condition

- Sometimes package of interventions rather than single ‘key’ intervention
Amenable mortality construct: categorical attribution or counterfactual modelling?

- Categorical attribution implies simplistic notion of causality

- Yet this is the method used to assign COD in the first place (rule based ‘all or nothing’ ICD coding)

- So reasonable to use same logic to further classify COD as amenable or nonamenable

- Differs from counterfactual modelling approach used for preventable mortality

- Note that amenable mortality has property of additive decomposition whereas preventable mortality does not
Amenable mortality construct: lag period

- Amenable mortality intended to serve as indicator of *current*, not future, health system performance

- So lag period must be short (intervention must act quickly)

- Arbitrary threshold of 5 years selected, in keeping with use of 5 year relative survival to define a ‘cure’ in cancer epidemiology

- Most long lag period interventions are intersectoral or population-level interventions anyway
Amenable mortality construct: lead period

• Amenable mortality intended to serve as indicator of current, not past, health system performance

• So lead period must be short – only recently introduced interventions should be included

• Arbitrary threshold of 40 years selected (to allow time for dissemination / incremental improvement – “effective coverage”)

• Threshold doesn’t matter much because of ‘rare cause of death’ criterion
Amenable mortality construct: rare causes of death

- Need to avoid cluttering the list with conditions that are ‘avoided’ rather than ‘avoidable’

- Arbitrary threshold: condition must account for >0.1% of all eligible deaths at end of observation period
Amenable mortality construct: extent of mortality reduction

- Evidence of effectiveness must be based on RCTs or major cohort studies

- However, poor state of evidence means that few condition-intervention pairs would make it through this filter if effectiveness threshold set too high eg 50%

- Arbitrary decision made to set the threshold at 30% so as to provide a more comprehensive indicator of health system performance

- 30% threshold does not mean that mortality from the condition must have decreased by >30% over the observation period (because incidence may have increased)
Amenable mortality construct: upper age limit

- Traditionally, deaths at older ages (65+) have been considered ineligible – although in recent years threshold of 75 has been used

- Epidemiological argument – age limit ageist and also unnecessary once explicit effectiveness criterion (>30%) applied (lack of RCTs will exclude older people anyway)

- Policy argument – political impact greater if deaths seen to be both unnecessary and untimely (“premature” death – fair innings argument)

- Technical argument – COD assignment and coding problematic for deaths at older ages because of comorbidity

- Plus lower quality diagnosis, COD assignment and coding for deaths at older ages independent of comorbidity
Amenable mortality: assigning COD in the face of co-morbidity

Comorbidity prevalence, 2006/07 NZHS

![Bar chart showing comorbidity prevalence across different age groups (25-44, 45-64, 65-74, 75-84, 85+). The x-axis represents age groups and the y-axis represents percent. The bars show the prevalence with error bars indicating variability.]
Amenable mortality construct: upper age limit

• If argument for upper age limit accepted, what should this threshold be?

• If meant to reflect life expectancy, should it be higher for females than males (eg 80 for males and 85 for females)?

• If based on ‘fair innings’ argument, should it be 85 rather than 75, at least in HICs?

• For the time being we have retained the arbitrary threshold of 75 years (ie only deaths at ages 0-74 years are eligible) – so limiting usefulness of the indicator wrt older age groups
Amenable mortality: How to set the upper age limit?

• Current period or cohort life expectancy

• Model lifetable

• Fixed limit - <85 for high income countries
  <75 as a global compromise
Amenable mortality: the concept clarified

• Amenable mortality defined by a list of condition – intervention pairs applied to deaths under age 75 years (‘premature’ deaths)

• To be included on the list, the ‘key’ intervention must be specified and shown (by RCTs or observational studies) to be capable of reducing mortality from the linked condition by >30% within 5 years of effective coverage

• Furthermore, the intervention must have been introduced within the past 40 years, and the condition must still account for >0.1% of all under 75 deaths

• Note that codelist will require updating every decade or so – which makes time series problematic
## Amenable mortality: current codeset

<table>
<thead>
<tr>
<th>Group</th>
<th>Condition</th>
<th>ICD-9</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVD &amp; diabetes</td>
<td>Diabetes</td>
<td>250</td>
<td>E10-E14</td>
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<tr>
<td></td>
<td>Valvular heart disease</td>
<td>391-394-398, 421.0, 424</td>
<td>I01, I05-I09, I33-I37</td>
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<tr>
<td></td>
<td>Hypertensive diseases</td>
<td>402-403</td>
<td>I10-I15</td>
</tr>
<tr>
<td></td>
<td>Coronary disease</td>
<td>410-414</td>
<td>I20-I25</td>
</tr>
<tr>
<td></td>
<td>Heart failure</td>
<td>429</td>
<td>I50</td>
</tr>
<tr>
<td></td>
<td>Cerebrovascular diseases</td>
<td>430-438</td>
<td>I60-I69</td>
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<tr>
<td>Other chronic disorders</td>
<td>Renal failure</td>
<td>584-585</td>
<td>N17-N18</td>
</tr>
<tr>
<td></td>
<td>Pulmonary embolism</td>
<td>453</td>
<td>I26</td>
</tr>
<tr>
<td></td>
<td>COPD</td>
<td>491</td>
<td>J42</td>
</tr>
<tr>
<td></td>
<td>Asthma</td>
<td>493</td>
<td>J45-J46</td>
</tr>
<tr>
<td></td>
<td>Peptic ulcer disease</td>
<td>531-532</td>
<td>K25-K26</td>
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<td></td>
<td>Cholelithiasis</td>
<td>574</td>
<td>K80</td>
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<tr>
<td>Injuries</td>
<td>Suicide</td>
<td>E950-E959</td>
<td>X60-X84</td>
</tr>
<tr>
<td></td>
<td>Road traffic accidents</td>
<td>E812, E814-E815</td>
<td>V01-V79, V87, V89, V99</td>
</tr>
<tr>
<td></td>
<td>Falls (#NOF)</td>
<td>E820</td>
<td>S72</td>
</tr>
<tr>
<td></td>
<td>Burns</td>
<td>E940-E949</td>
<td>T20-T31</td>
</tr>
<tr>
<td></td>
<td>Adverse health care events (subset)</td>
<td>E870-E876</td>
<td>T80-T88</td>
</tr>
<tr>
<td>Infections</td>
<td>Pulmonary tuberculosis</td>
<td>11</td>
<td>A15</td>
</tr>
<tr>
<td></td>
<td>Meningococcal disease</td>
<td>036</td>
<td>A39</td>
</tr>
<tr>
<td></td>
<td>Pneumococcal disease</td>
<td>481, 038.2, 320.1</td>
<td>J13, A40.3, G00.1</td>
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<tr>
<td></td>
<td>HIV/AIDS</td>
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<td>B20-B24</td>
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<tr>
<td>Cancers</td>
<td>Stomach</td>
<td>151</td>
<td>C16</td>
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<tr>
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<td>Rectum</td>
<td>154</td>
<td>C19-C21</td>
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<td>Melanoma</td>
<td>172</td>
<td>C43</td>
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<tr>
<td></td>
<td>Female breast</td>
<td>174</td>
<td>C50</td>
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<tr>
<td></td>
<td>Cervix</td>
<td>180</td>
<td>C53</td>
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<tr>
<td></td>
<td>Testis</td>
<td>186</td>
<td>C62</td>
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<tr>
<td></td>
<td>Prostate</td>
<td>185</td>
<td>C61</td>
</tr>
<tr>
<td></td>
<td>Thyroid</td>
<td>193</td>
<td>C73</td>
</tr>
<tr>
<td></td>
<td>Bone &amp; cartilage</td>
<td>170</td>
<td>C40-C41</td>
</tr>
<tr>
<td></td>
<td>Hodgkins</td>
<td>201</td>
<td>C81</td>
</tr>
<tr>
<td></td>
<td>Acute lymphocytic leukemia</td>
<td>204.0</td>
<td>C91.0</td>
</tr>
</tbody>
</table>
Amenable mortality in 65-74 year olds: New Zealand 2006

Males

Age specific rates per 100,000

Females

Age specific rates per 100,000
Amenable mortality: causal structure at age 65-74, New Zealand 2006
Amenable mortality in old age: trans Tasman comparison, 1997-2006

PREDICTED amenable mortality, 65-74 yrs - GDP x COUNTRY interaction

Year
Rate per 100,000
0 200 400 600 800 1000 1200 1400
NZ AU

NZ
AU
Amenable mortality: NZ health districts, 2006 (age and sex adjusted)
Amenable mortality: NZ health districts, 2006 (age, sex, ethnicity and deprivation adjusted)
Measuring avoidable mortality at older ages in low/mid income countries

- Preventable mortality
  - identify key risk / protective factors
  - monitor prevalences via survey
  - use hazard ratios for all cause mortality (from WHO)
  - mortality projections from national statistical office
  - run policy-relevant intervention scenarios (with sensitivity analysis)
Measuring avoidable mortality at older ages in low/mid income countries

• Amenable deaths
  - restrict to <75 yrs of age ?
  - adopt ‘NZ’ definition & codelist ?
  - assess whether COD coding quality sufficient (redistribute garbage codes) ?

• Reality is that poor quality COD data, and current lack of standardisation of the metric, may limit usefulness of this indicator in the short term
Does the ‘amenable mortality’ construct translate well for older ages?

- Traditionally, older people have been excluded

- Yet data quality (COD assignment and coding) has improved in recent years, as has evidence for effectiveness of interventions in older people

- Co-morbidity could (possibly) be dealt with by multiple COD coding (followed by appropriate statistical analysis), so better estimating contribution of different diseases to old age mortality

- At present, more an area for further research than routine monitoring – especially wrt 85+ age group

- Extension of upper age limit to 85 yrs, or dropping it altogether, warrants serious consideration