Health gain and cost-effectiveness in cancer prevention and management
Overview

• What we do: prevention ↔ palliation

• What we will tell you today:
  o **HPV vaccination** - it will take very cheap vaccine cost and very cheap administration costs before vaccinating boys will be cost-effective.
  o **Colorectal cancer screening** - very cost-effective overall, but is not going to reduce health inequalities
  o **Cancer care coordinators (patient navigators)** - probably cost effective
  o **Trastuzumab (i.e. Herceptin)** varies enormously in cost effectiveness by hormone status and age. Given personalized medicine, why are funding decisions are not also made by clinical and demographic groupings?
  o **Single fractionated radiotherapy** - just as effective as multiple fractionated radiotherapy for metastatic bone pain. Why are we still providing multiple fractionated radiotherapy, wasting precious health system resources?

• What we can tell you tomorrow:
  o **Knowledge translation**: website, data tools, blogs and site visits.
What we do

☑️ Cost-effectiveness

What do we do more of?
What do we do less of?
Is this a sensible thing to do?
Who should get this?

- Cancer care coordinators for colon cancer
- Cancer care coordinators for breast cancer
- Taxanes for breast cancer
- Radiotherapy for bone metastases
- HPV vaccination for girls
- HPV vaccination for boys
- Tobacco taxes
- Restricting tobacco outlets
- CT screening for lung cancer
- Colorectal cancer screening
- Salt reduction
- Housing interventions
How we do it

INPUTS

MODEL

OUTPUTS

Cost-effectiveness
INPUTS

Colon cancer incidence
Colon cancer mortality
Colon cancer morbidity
Colon cancer costs
Background mortality
Background morbidity
Background health system costs
Baseline wait time to surgery
Baseline wait time to chemo
Baseline uptake of chemo
CCC effect on wait time to surgery
CCC effect on wait time to chemo
CCC effect on chemo coverage
CCC cost
Overview

• What we do: prevention ↔ palliation

• What we will tell you today:
  o **HPV vaccination** - it will take very cheap vaccine cost and very cheap administration costs before vaccinating boys will be cost-effective.
  o **Colorectal cancer screening** - very cost-effective overall, but is not going to reduce health inequalities
  o **Cancer care coordinators (patient navigators)** - probably cost effective
  o **Trastuzumab (i.e. Herceptin)** varies enormously in cost effectiveness by hormone status and age. Given personalized medicine, why are funding decisions are not also made by clinical and demographic groupings?
  o **Single fractionated radiotherapy** - just as effective as multiple fractionated radiotherapy for metastatic bone pain. Why are we still providing multiple fractionated radiotherapy, wasting precious health system resources?

• What we can tell you tomorrow:
  o **Knowledge translation**: website, data tools, blogs and site visits.
HPV vaccination

Human papillomavirus (HPV)
- Cancer of cervix, anus, oropharynx
- Genital warts

NZ HPV vaccination programme
School age girls
3 doses
In school or through primary care provider
HPV vaccination in girls

Vaccinating girls cost-effective at:
- $18,800 per QALY gained for current school-programme (compared with no vaccination)
- $34,700 for intensified school programme c.f. above
- Not cost-effective to be mandatory ($122,500 per QALY gained)
HPV vaccination in boys

Vaccinating boys not cost-effective at $247,000 ($119,000 - $474,000) per QALY gained for BOYS added to intensive GIRLS.
Colorectal Cancer Screening
Preliminary, not for dissemination

- CRC screening high cost effective … lets get on with it… but lets not pretend it will reduce health inequalities…..
- Reducing health inequalities occurs elsewhere (e.g. tobacco control, food taxes and subsidies)
Cancer care coordinators

Cancer services a national priority

- ‘continuity of care’
- ‘a single point of contact’
- 2012 Budget: $16 million for care coordination nurses

patient navigators
key workers
liaison nurses
case managers
care coordinators
Cancer care coordinators in stage III colon cancer

Clinical nurse specialist
Hospital-based
versus ‘usual practice’

Reduce time to surgery
Reduce time to chemotherapy
Increase chemo coverage
Improve patient QOL
Cancer care coordinators in stage III colon cancer

CE threshold: $45,000 per QALY

ICER: $18,900 per QALY
($13,400 to $24,600)
But not the same for everyone

ICER $9,400 per QALY

ICER $23,600 per QALY

< 65 years

>= 65 years
Overview

• What we do: prevention ↔ palliation

• What we will tell you today:
  o HPV vaccination - it will take very cheap vaccine cost and very cheap administration costs before vaccinating boys will be cost-effective.
  o Colorectal cancer screening - very cost-effective overall, but is not going to reduce health inequalities
  o Cancer care coordinators (patient navigators) - probably cost effective
  o Trastuzumab (i.e. Herceptin) varies enormously in cost effectiveness by hormone status and age. Given personalized medicine, why are funding decisions not also made by clinical and demographic groupings?
  o Single fractionated radiotherapy - just as effective as multiple fractionated radiotherapy for metastatic bone pain. Why are we still providing multiple fractionated radiotherapy, wasting precious health system resources?

• What we can tell you tomorrow:
  o Knowledge translation: website, data tools, blogs and site visits.
Herceptin in node+ HER2+ early breast cancer

12 month regimen of Herceptin versus no Herceptin

Approx. NZ$ 70,000 per year at formulary prices

How does cost-effectiveness differ by:
• age?
• oestrogen receptor (ER) and progesterone receptor (PR) status?
Herceptin in **HER2+ breast cancer**

<table>
<thead>
<tr>
<th>ICERs</th>
<th>ER+/PR+</th>
<th>ER+/PR−</th>
<th>ER−/PR+</th>
<th>ER−/PR−</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-44</td>
<td>73,529</td>
<td>56,181</td>
<td>37,003</td>
<td>34,206</td>
<td>46,151</td>
</tr>
<tr>
<td>45-54</td>
<td>98,687</td>
<td>74,469</td>
<td>47,272</td>
<td>43,160</td>
<td>59,319</td>
</tr>
<tr>
<td>55-64</td>
<td>96,680</td>
<td>73,735</td>
<td>48,117</td>
<td>44,293</td>
<td>59,674</td>
</tr>
<tr>
<td>65-74</td>
<td>102,266</td>
<td>79,335</td>
<td>54,172</td>
<td>50,564</td>
<td>65,751</td>
</tr>
<tr>
<td>75-84</td>
<td>170,176</td>
<td>130,817</td>
<td>87,237</td>
<td>80,857</td>
<td>105,894</td>
</tr>
<tr>
<td>≥ 85</td>
<td>337,945</td>
<td>255,681</td>
<td>162,962</td>
<td>148,919</td>
<td>198,365</td>
</tr>
</tbody>
</table>

*ER* estrogen receptor; *ICER* incremental cost-effectiveness ratio; *PR* progesterone receptor.

Under review
Single versus multiple fractionated radiotherapy for metastatic bone pain

- Evaluated across breast, prostate, and lung cancer
- Found single-fractionated external beam radiotherapy (SFX-EBRT) gained as many QALYs as multiple-fractionated radiotherapy (MFX-EBRT) for patients with localised metastatic bone pain
- But SFX-EBRT was considerably cheaper and thence clearly more cost-effective.
- Pathological fracture had a negligible impact on health gain and cost-effectiveness.
The beginnings of a league table

Eliminate all CVD for 2011 population followed till death

25% mandatory salt reduction in all processed foods, total 2011 population

25% mandatory salt reduction three processed food groups, total 2011 population

20% tobacco tax 2011-31, total 2011 population followed till death

10% tobacco tax p.a. 2011-31, total 2011 population followed to death

Current HPV vaccination 12 year old girls in 2011

PRELIMINARY RESULTS — will change a little with pending improvements. Not for citation
Overview

• What we do: prevention ↔ palliation

• What we will tell you today:
  o **HPV vaccination** - it will take very cheap vaccine cost and very cheap administration costs before vaccinating boys will be cost-effective.
  o **Colorectal cancer screening** - very cost-effective overall, but is not going to reduce health inequalities
  o **Cancer care coordinators (patient navigators)** - probably cost effective
  o **Trastuzumab (i.e. Herceptin)** varies enormously in cost effectiveness by hormone status and age. Given personalized medicine, why are funding decisions are not also made by clinical and demographic groupings?
  o **Single fractionated radiotherapy** - just as effective as multiple fractionated radiotherapy for metastatic bone pain. Why are we still providing multiple fractionated radiotherapy, wasting precious health system resources?

• What we can tell you tomorrow:
  o **Knowledge translation**: website, data tools, blogs and site visits.
Research dissemination & translation: BODE³ website = ‘hub’

www.otago.ac.nz/bode3

Publications
Presentations
Video clips
Plain language summaries
Public Health Expert Blog
Rapid assessment tools
Data
**HPV Vaccination of School-Age Girls**

**comparing the cost-effectiveness of 3 delivery programmes**

**SUMMARY**

Human papillomaviruses (HPV) are common sexually transmitted viruses. They can cause several types of cancer (such as cancers of the cervix, anus, and oropharynx) and illnesses like genital warts. New Zealand has a national HPV vaccination programme aimed at preventing these diseases. Three doses of HPV vaccine (Gardasil) are currently offered to 11-year-old girls, in school or through their primary care provider. This pamphlet compares the cost-effectiveness of the existing HPV vaccination programme to two other alternative vaccine delivery programmes with higher estimated coverage. All three programmes vaccinate only school-age girls, but we include benefits to both males and females (via herd immunity) in our evaluation.

We evaluated three HPV vaccine delivery programmes:

- **Current**: what we do currently, where the vaccine is offered through schools or primary care. The observed coverage is only 47%.
- **Interfused School-based**: where the vaccine is offered only through schools. The estimated coverage is 73%.
- **Mandatory School-based**: where the vaccine is offered through schools and a new law requires parents to actively opt-out if they do not want their daughter vaccinated. The estimated coverage is 93%.

These were:

- **Current**: what we do currently, where the vaccine is offered through schools or primary care. The observed coverage is only 47%.
- **Interfused School-based**: where the vaccine is offered only through schools. The estimated coverage is 73%.
- **Mandatory School-based**: where the vaccine is offered through schools and a new law requires parents to actively opt-out if they do not want their daughter vaccinated. The estimated coverage is 93%.

For each programme, the model estimates how much health benefit is gained (in quality-adjusted life-years or QALYs), and how much it costs the health system. These are combined into a single incremental Cost-Effectiveness Ratio or ICER.

The greatest health gain was from the prevention of genital warts, with smaller gains from reduced rates of cervical, oropharyngeal, and anal cancer. Moving from no vaccination to the **Current** programme gives 266 QALYs gained, at a net cost of NZ$ 4.65 million per year. Moving from Current to **Interfused School-based** adds 82 QALYs, at an extra net cost of NZ$ 2.77 million per year. Moving from there to **Mandatory School-based** adds another 35 QALYs, but for an additional net cost of NZ$ 3.70 million per year (mainly from the cost of passing the law).

**Trastuzumab (Herceptin)**

**in Breast Cancer**

**cost-effectiveness in regional breast cancer**

Growth factor receptor 2-positive (HER2+): tends to be more aggressive, more resistant and poorer prognosis. In women who have HER2+ breast cancer who also have involved lymph nodes, 12 months of Herceptin added to standard chemotherapy reduces risk of breast cancer alone. Herceptin is however expensive (an added cost of NZ$ 74,000 in NZ), associated with side effects. We evaluated the cost-effectiveness of 12 months of Herceptin added to standard chemotherapy alone. We specifically investigated Herceptin’s cost-effectiveness in breast cancer subtypes, representing relatively good to relatively poor prognosis.

Herceptin is given intravenously every three weeks for a total period of 12 months, and patients also have cardiac monitoring scans every 3 months to monitor for the risk of heart failure. The target population is women with node-positive (regional) HER2+ breast cancer who are fit for Herceptin on initial cardiac assessment. They are further divided into four different breast cancer subtypes, defined by estrogen receptor (ER) status and progesterone receptor (PR) status. ER+/PR+ HER2+ subtype has the best prognosis. ER-/PR-/HER2- has the worst prognosis, and the other two subtypes fall in between these two extremes.

For each subtype, the model estimates how much health benefit is gained (in quality-adjusted life-years) from Herceptin, and how much it costs or saves the health system. These are combined into a single incremental Cost-Effectiveness Ratio or ICER.

The cost-effectiveness of 12 months of Herceptin for early regional breast cancer varied markedly by breast cancer subtype and by age. The best prognosis subtype (ER+/PR+ HER2+) the cost-effectiveness ranged from NZ$ 75,500 per QALY for 25-44 year-old women, through to NZ$ 338,000 per QALY for women who were 85+ years. For the worst prognosis subtype (ER-/PR-/HER2+), it ranged from NZ$ 342,000 per QALY for 25-44 year-olds.
Can CT screening for lung cancer in New Zealand be cost-effective?

Monday, September 28th, 2015 | Kate Sloane | 5 Comments

There is now strong evidence that screening for lung cancer with low-dose computed tomography (LDCT) scans is effective at reducing lung cancer mortality. So why aren’t countries rushing to introduce a screening programme? Because there is still doubt about its cost-effectiveness. In this blog, we discuss the uncertainties and suggest a
Rapid Assessment Tools

**Baseline Parameters**
- **5 yr RSR**: 90%
- **Disease Cost**
  - First year of diagnosis: $10,000
  - Last year of life: $20,000
  - Remission: $3,000
- **Disutilities**
  - First year of diagnosis: 0.4
  - Last year of life: 0.6
  - Remission: 0.3

**Heterogeneity**
- **Sex**: Female
- **Age**: 55

**Intervention**
- **Effect size (HR)**: 0.7
- **Intervention Cost**
  - First year: $10,000
  - Second year: $5,000

**Model Structure**
- **Discount rate**: 3%
- **Annual decline in BMR**: 2%
- **CE Threshold**: $45,000

**RESULTS**

<table>
<thead>
<tr>
<th>Comparator</th>
<th>QALYs</th>
<th>Costs</th>
<th>Incr QALY</th>
<th>Incr Costs</th>
<th>ICER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparator</td>
<td>14.2</td>
<td>$93,746</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>14.6</td>
<td>$123,177</td>
<td>0.43</td>
<td>$29,431</td>
<td>$69,204</td>
</tr>
</tbody>
</table>

**Incremental cost-effectiveness plane**

Incremental costs in NZS:
- $0 to $35,000

Incremental QALYs gained:
- 0 to 0.45
# Data

## RESULTS

<table>
<thead>
<tr>
<th>Age group</th>
<th>A - Citizen cost not last 6 months of life, without tobacco related disease</th>
<th>B - Citizen cost in last 6 months of life, without tobacco related disease</th>
<th>C - A = ‘Excess’ costs of specified disease in first year of diagnosis</th>
<th>D - A = ‘Excess’ costs of having prevalent specified disease</th>
<th>E - A = ‘Excess’ cost of being in last 6 months of life if dying from specified disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$4,599</td>
<td>$76,154</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>1-4</td>
<td>$1,068</td>
<td>$16,579</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>5-9</td>
<td>$549</td>
<td>$20,027</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>10-14</td>
<td>$540</td>
<td>$17,004</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>15-19</td>
<td>$870</td>
<td>$12,447</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>20-24</td>
<td>$1,129</td>
<td>$17,756</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>25-29</td>
<td>$1,235</td>
<td>$14,752</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>30-34</td>
<td>$1,385</td>
<td>$18,622</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>35-39</td>
<td>$1,277</td>
<td>$18,568</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>40-44</td>
<td>$1,093</td>
<td>$19,769</td>
<td>$19,565</td>
<td>$3,047</td>
<td>$35,997</td>
</tr>
<tr>
<td>45-49</td>
<td>$1,189</td>
<td>$19,545</td>
<td>$18,517</td>
<td>$1,803</td>
<td>$28,765</td>
</tr>
<tr>
<td>50-54</td>
<td>$1,311</td>
<td>$21,082</td>
<td>$18,517</td>
<td>$1,803</td>
<td>$28,765</td>
</tr>
<tr>
<td>55-59</td>
<td>$1,485</td>
<td>$20,042</td>
<td>$18,517</td>
<td>$1,803</td>
<td>$28,765</td>
</tr>
<tr>
<td>60-64</td>
<td>$1,748</td>
<td>$17,130</td>
<td>$18,517</td>
<td>$1,803</td>
<td>$28,765</td>
</tr>
<tr>
<td>65-69</td>
<td>$2,233</td>
<td>$16,780</td>
<td>$20,549</td>
<td>$2,932</td>
<td>$32,827</td>
</tr>
<tr>
<td>70-74</td>
<td>$2,658</td>
<td>$16,894</td>
<td>$20,549</td>
<td>$2,932</td>
<td>$36,110</td>
</tr>
<tr>
<td>75-79</td>
<td>$3,107</td>
<td>$12,630</td>
<td>$25,529</td>
<td>$4,666</td>
<td>$15,918</td>
</tr>
<tr>
<td>80-84</td>
<td>$3,548</td>
<td>$13,063</td>
<td>$25,529</td>
<td>$4,666</td>
<td>$17,366</td>
</tr>
<tr>
<td>85-89</td>
<td>$3,887</td>
<td>$9,810</td>
<td>$19,297</td>
<td>$3,344</td>
<td>$17,366</td>
</tr>
<tr>
<td>90-94</td>
<td>$4,006</td>
<td>$9,118</td>
<td>$19,297</td>
<td>$3,344</td>
<td>$18,813</td>
</tr>
<tr>
<td>95-99</td>
<td>$3,585</td>
<td>$6,639</td>
<td>$19,297</td>
<td>$3,344</td>
<td>$18,813</td>
</tr>
</tbody>
</table>
Who we are
Health gain and cost-effectiveness in cancer prevention and management