Evidence-based population model of local control and overall survival benefit of radiotherapy

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Radiotherapy utilisation

Source: Atun R et al, Expanding global access to radiotherapy, Lancet Oncol 2015; 16: 1153–86
Population-based model

• Population - All patients in a region with a given cancer or group of cancers

• Population-based demand models provide means for (Hanna and Shafiq, 2015)
  • Estimating optimal proportion needing treatment
  • Treatment benefit achievable under optimal condition

• Can be used for different treatment modalities and different outcomes
Radiotherapy utilisation and benefit models

• Radiotherapy indications are based on evidence of superior clinical outcomes (Delaney et al 2003)

• Population-based radiotherapy utilisation (RTU) model
  • 48% of all cancer patients need radiotherapy (Barton et al 2012)

• RTU models further extended to estimate the local control and overall survival benefits
Methods flowchart

1. Identify Radiotherapy Indications
2. Explore Epidemiological Data
3. Define Indication Benefit
4. Estimate Population Benefit

- Evidence-based guidelines
- Population databases
- Published clinical trials
- Sensitivity analyses
Evidence

PMRT 1-3 nodes

No RT  56.5%
RT   53.5%

20-year gain  3.0 % (SE 3.1)
RR 0.89 (95% CI 0.77–1.04)
logrank 2p > 0.1; NS

PMRT 4+ nodes

No RT  82.7%
RT   75.1%

20-year gain  7.6 % (SE 2.8)
RR 0.89 (95% CI 0.78–1.00)
logrank 2p = 0.05

Source: EBCTCG 2014
Benefit models

- Brain
- Breast
- Head and Neck
- Gastrointestinal
- Genitourinary
- Gynaecological
- Haematological
- Lung
- Melanoma
- Unknown Primary
- Other: Anus, Small intestine, Biliary tract, Mesothelioma, Myelodysplastic syndrome, Non-melanoma skin cancer, Sarcomas and rare cancer
5-yr OS model - lung cancer
## Benefit for top most cancers in Australia

<table>
<thead>
<tr>
<th></th>
<th>5-yr LC benefit (%)</th>
<th>5-yr OS benefit (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RT alone vs No RT</td>
<td>Concurrent CRT vs RT alone</td>
</tr>
<tr>
<td>Prostate</td>
<td>25%</td>
<td>0%</td>
</tr>
<tr>
<td>Colon</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Rectum</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Breast</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>Melanoma</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Lung</td>
<td>7%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*RT alone vs No RT
Concurrent CRT vs RT alone
Total*
5-yr LC benefit by cancer sites
5-yr OS benefit by cancer sites
Sensitivity analysis

Tornado Diagram
5-year Overall Survival Benefit Radiotherapy Alone

- 2.29%
- 2.35%
- 2.45%
Population benefit for all cancers

- The model estimate of benefits with 95% CI

  A) Radiotherapy alone:
  - 5-year local control – 10.8% (9.3, 11.8)
  - 5-year overall survival – 2.4% (2.1, 2.7)

  B) Concurrent chemo-radiotherapy:
  - 5-year local control – 0.5% (0.5, 0.6)
  - 5-year overall survival – 0.3% (0.2, 0.4)
Conclusion

*If guidelines recommended radiotherapy is applied to whole cancer population*

- For 123532 new cancer cases in Australia (AIHW 2013)
  - 5-year local control benefit in 13571 cases
  - 5-year overall survival benefit in 3485 cases
- If only curative radiotherapy indications are considered the no. of people with benefit would be doubled
Future work

The potential for evidence-based models

- To inform economic analyses of treatment service need
- To assess shortfalls in service provision at the population level
- Planning for equitable services across population
## Publications


Thank you