Multiple Cohort Modelling of Long-Duration Interventions: Questioning Time Horizons & Aggregation Across Cohorts

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Health Research Board

NCI CISNET comparative modelling network
Overview

Background to single and multi-cohort modelling

Our research question

Methods

Results and interpretation

Discussion and conclusion
Background: Model Types

Single cohort:
   one group of patients starting an intervention at one point in time

Multiple cohort:
   multiple cohorts starting the intervention at the same or different points in time

Population:
   multiple cohorts modelled with an intervention ceasing at an implementation time horizon
Background: Rationale for model types

Single Cohort
- Simple and intuitive

Multi Cohort
- More representative of actual implementation across cohorts
- Necessary in the case of infectious diseases

Population
- Limiting the model to a timeframe relevant to decision makers
Background: Literature

Literature on the number of cohorts to model is thin

Population modelling literature largely relates to infectious diseases

Dewilde and Anderson (2004) Medical Decision Making
  - Recognised the issue of prevalent cohorts in long-duration interventions
  - Demonstrated the issue using simulation of mammography screening

Hoyle and Anderson (2010) Medical Decision Making
  - Recognised the significance of future incident cohorts
  - Recommended modelling prevalent and all future incident cohorts
Background: CISNET Colorectal

Review of methodology used in the 7 published CEAs from the NCI CISNET comparative modelling programme:

- 6 used single cohort models
- 1 used a population model
- no study used a multiple cohort model
Research Question

What type of model should we use for a long-duration interventions:

- Single or multiple cohorts?

- Implementation time horizons?
Methods

MISCAN microsimulation model of colorectal cancer screening used to model annual FOBT between ages 50-74

Equal discounting of costs and effects of 5%

Previous history of opportunistic screening included

Outcome measure of cost per life-years gained (LYG)

Modelled single cohort, multiple cohort and population (30 time horizon) models and compared the results
Prevalent and Incident Cohorts

Calendar time

Screening starts 2010

5 incident cohorts

25 prevalent cohorts
## Results: Incident vs Prevalent Cohorts

<table>
<thead>
<tr>
<th>Cohorts Modelled, (age in 2010)</th>
<th>Cost-Effectiveness Ratio, $/LYG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident Cohorts (46-50)</td>
<td>2,350</td>
</tr>
<tr>
<td>Prevalent &amp; Incident Cohorts (46-75)</td>
<td>2,040</td>
</tr>
</tbody>
</table>
Population and Multi Cohort Models

- Screening starts 2010
- Time Horizon 2039

- 5 complete incident cohorts
- 25 constrained incident cohorts

25 prevalent cohorts

Calendar time
### Results: Population vs Multi Cohort Model

<table>
<thead>
<tr>
<th>Scenario Modelled</th>
<th>Cost-Effectiveness Ratio, $/LYG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Model (2039 Implementation Horizon)</td>
<td>2,120</td>
</tr>
<tr>
<td>Multi Cohort Model (No Implementation Horizon)</td>
<td>1,990</td>
</tr>
</tbody>
</table>
Discussion (1/3)

Implementation horizons seem wrong in principle:

- Intervention is modelled as stopping early
- Cost-effectiveness of partial screening not necessarily equal to that of a completed programme

In practice, imposing a horizon made little difference:

- Changes in costs and effects occur at least 30 years after the discount year; following discounting they are small relative to the totals for all cohorts in the model
Discussion (2/3)

Differences between the incident and prevalent cohorts’ cost-effectiveness are also relatively small in this case.

CE estimates from multiple cohort models are aggregate estimates across those cohorts.

However, per-cohort CE estimates may suggest different decisions than aggregate estimates, both for:

1. simple yes/no reimbursement decisions
2. choice of optimal intervention intensity with respect to a cost-effectiveness threshold
Discussion (3/3)

Furthermore, aggregate multi-cohort estimates depend on the relative number of prevalent and (future) incident cohorts.

The number of future cohorts is unknowable, consequently estimates seem arbitrary.

Therefore, consideration of population or multi cohort modelling leads to questions regarding the aggregation of cost-effectiveness estimates across cohorts.
Conclusions

Single cohort models are likely to remain a common choice.

Multi-cohort modelling requires a debate regarding the appropriateness of aggregation across cohorts.

Cost-effectiveness estimates disaggregated per cohort may be a useful complementary analysis in some cases.

The impact of implementation time horizons is attenuated by discounting.
References

