Cohort, Multi-Cohort or Population Model? Why, When and How?

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Overview

Defining cohorts

Single or multiple cohorts

Three interpretations of population models

Application to CEA

Semantics of Structure & Reporting

Interpretation of model structure depends on how results are reported

Separate reporting for different groups considered separate models

Defining Cohorts 1

Cohort vs individual based simulation
- cohort moves through model together
- individuals pass through separately

Not the cohort model considered here

Defining Cohorts 2

Cohort defined by intervention start date

- mixed aged cohorts
- corresponds with typical intervention use

Cohort defined by birth year

- intervention starts at particular age
- risk may vary with age

Intervention Durations

Short duration interventions

- acute care
- vaccination

Long duration interventions

- treatment for chronic conditions
- screening

Single vs Multiple Cohorts

Shared effects

- infectious diseases

Multiple recipient cohorts & subgroup analysis

- different risk subgroups

Changing cost-effectiveness over time

- patent expiry, differential discounting, herd immunity

Examples from the Literature

Jit et al (2008) Economic evaluation of human papillomavirus vaccination in the United Kingdom: *British Medical Journal*

Example of a study using multiple birth cohorts to capture the effects of herd immunity.

Tosteson et al (2008) Cost-Effectiveness of Digital Mammography Breast Cancer Screening: *Annals of Internal Medicine*

Example of a CEA considering a change in screening over all recipient cohorts together.

Prosser et al (2006) Health Benefits, Risks, and Cost-Effectiveness of Influenza Vaccination of Children: *Emerging Infectious Diseases*

Example of a model reporting cost-effectiveness outcomes stratified by mutually exclusive age and risk groups.

Hoyle (2011) Accounting for the Drug Life Cycle and Future Drug Prices in Cost-Effectiveness Analysis: *Pharmacoeconomics*

Methodological paper that considers how much more cost-effective drugs would appear if CEAs accounted for price reductions over their expected lifetime of use.

Population Models 1:
As models of all current recipients

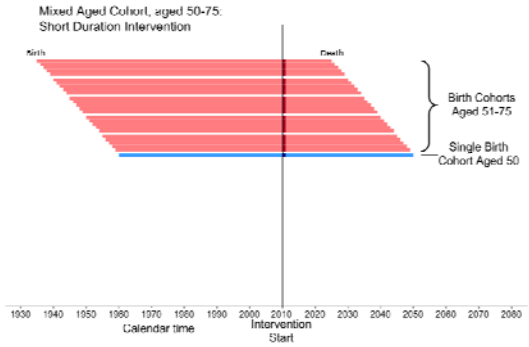
Model of all current recipients

- actual recipients may differ in age or other risk characteristics
- single cohort may be unrepresentative mix of recipients

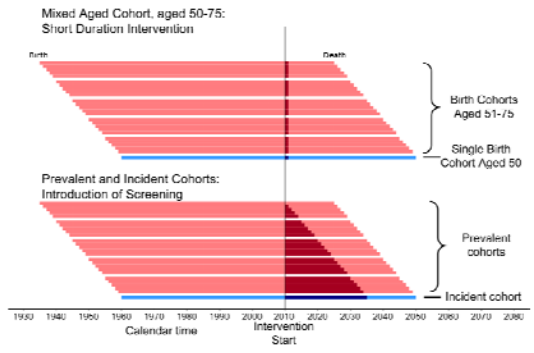
Matched to actual population distribution

- probably makes little difference non-elderly populations

Graphical Example 1



Graphical Example 1



Examples from the Literature

Hillner and Smith (1991) Efficacy and Cost Effectiveness of Adjuvant Chemotherapy in Women with Node-Negative Breast Cancer: *New England Journal of Medicine*

Example of CEA using two cohorts aged 45 and 60, whereas actual recipients will be of mixed ages.

Khandker et al (2000) A Decision Model and Cost-Effectiveness Analysis of Colorectal Cancer Screening and Surveillance Guidelines for Average Risk Adults: *International Journal of Technology Assessment in Health Care*

Example of a screening CEA that considers the current cohorts on aggregate.

Dewilde and Anderson (2004) The Cost-Effectiveness of Screening Programs Using Single and Multiple Birth Cohort Simulations: *Medical Decision Making*

Methodological paper highlighting the difference between single and multiple cohort models in the case of screening; it advocates modelling all current cohorts.

Population Models 2: As open models

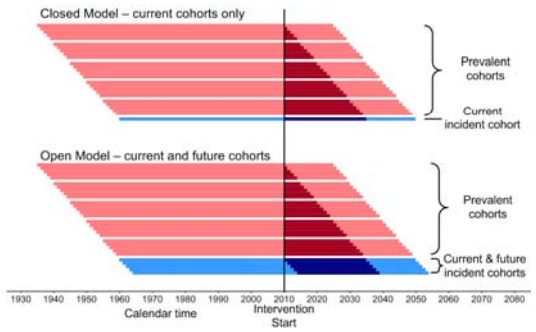
Interpretation as "open"
– allowing cohorts to enter over time

Cohort characteristics may differ over time
e.g. introduction of screening

Costs and effects may vary over intervention lifetime

Otherwise, additional cohorts unlikely to matter

Graphical Example 2



Examples from the Literature

Tosteson et al (2008) Cost-Effectiveness of Digital Mammography Breast Cancer Screening, *Annals of Internal Medicine*

Stout et al (2006) Retrospective Cost-effectiveness Analysis of Screening Mammography, *Journal of the National Cancer Institute*

Tostesen is an example of a closed model in which no new recipient cohorts enter after the start date, whereas Stout is a open model that adds new cohorts over time.

Hoyle and Anderson (2010) Whose Costs and Benefits? Why Economic Evaluations Should Simulate Both Prevalent and All Future Incident Patient Cohorts: *Medical Decision Making*

Methodological paper recognising the issue of the change of composition over time. Advocates modelling all recipient cohorts over an intervention's implementation lifetime.

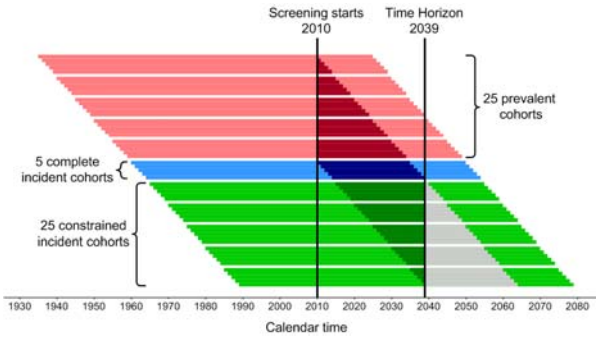
Population Models 3: As cross-sectional models

Time horizons:

- effects horizon
- implementation horizon

Longitudinal vs cross-sectional interpretations

Graphical Example 3



Examples from the Literature

Gaspoz et al (2005) Cost Effectiveness of Aspirin, Clopidogrel, or Both for Secondary Prevention of Coronary Heart Disease; *The New England Journal of Medicine*

CEA employing a time horizon on costs and effects of 25 years.

Karnon et al (2007) A Critique and Impact Analysis of Decision Modeling Assumptions: *Medical Decision Making*

Methodological critique of effects time horizons using Gaspoz et al as an example.

Wilschut et al (2011) Cost-effectiveness Analysis of a Quantitative Immunochemical Test for Colorectal Cancer Screening; *Gastroenterology*

A CEA employing a lifetime time horizon for effects for all cohorts, but uses an implementation time horizon at which the intervention ceases for all irrespective of age.

Mauskopf (1998) Prevalence-Based Economic Evaluation: *Value in Health*

Methodological paper describing the differences between longitudinal and cross-sectional approaches and their suitability to CEA and BIA respectively.

Summary of Potential Problems

Inappropriate aggregation of heterogeneous cohorts:
- at one point in time
- over time

Mismatch with policy question

Misapplication of cross-sectional approach to CEA

3 Key Points

1. When a single cohort is not adequate and multiple cohorts are modelled, aggregating cohorts together rarely fits the policy question.

2. “Population model” is an ambiguous term

3. CEA is a longitudinal concept