An introduction to economic modelling in the context of HTA

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Host: COVID-END in Canada
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Outline

• Economic modeling & HTA (overview)
• Example: HTA process in BC
• Economic modeling process (five steps)
• Information base for the modeling
• Reviewing economic models
• Impact and summary
Decision analytic economic modeling and HTA

- In most cases clinical and economic evidence must be either transferred from one study population to another or combined and linked in some way – as such modeling becomes a viable option.

- Decision makers must balance the costs and consequences of adopting or discarding a health technology based on the available data -> HTA Process.

- HTA is a multidisciplinary process to evaluate the social, economic, organizational and ethical issues of a health intervention or health technology.

- HTA has different parts (e.g., clinical effectiveness and economic evaluation) and different approaches (qualitative and quantitative including -> Decision-analytic methods).
Mathematical modeling in epidemiology

- Two main types of models in examining how infectious diseases progress through a population: deterministic and stochastic (accounts for chance variations)

- Based on assumptions around effectiveness of a given intervention (amongst other things) and thus validity is only as good as those assumptions

- Provides information as to which interventions to implement for how long, and have a place when empirical data can’t be collected or prediction is required

- As we have seen with COVID modeling, these models can be updated regularly and can be an important part of the information base for public health responses

- All of that said, epidemiologic models are **NOT** the topic for today!
BC HTAC process and components

- New technologies and existing services (i.e., investment and reassessment)
  - Prioritization of topics by health technology assessment committee – 8-10 member advisory council, 2 public members, 5 secretariat members
  - BC Ministry has a defined set of criteria used to score the technologies
    - Condition severity
    - Evidence of effectiveness (health and non-health benefits)
    - Ethical considerations
    - Underserved populations
    - Evidence of cost-effectiveness
    - Environmental impact
    - Implementation considerations
    - Risk Registry

- 3 groups including C2E2 produce HTA reports (4-6 month process) for assessment by HTAC
- Public posting (review, redact, sign police communiqué, share publicly)
Decision-analytical model

- Context-specific issues
- Jurisdictional Scan
- Stakeholder & Patient perspectives
- Economic evaluations
- Clinical evaluations (RR)

HTA Components

- BC-specific economic evaluation
- BC-specific budget impact

Non-linear process and resource ($)
- Time (4-6m) and resource ($)
- Constraints
Decision analytic modeling

• A decision-analytic model uses mathematical relationships to define and compare a series of expected consequences that would result from the set of interventions or decision options being evaluated, by synthesizing information from multiple sources
  – Common simulation techniques: discrete-event simulation (DES), Markov-Monte Carlo simulation, microsimulation, hybrid models

• To identify interventions that produce the greatest health care benefit with the resources available

• NOT a complete procedure for determining resource allocation decisions as it CANNOT incorporate all the values and criteria relevant to such decisions.
Decision analytic modeling

• Best understood as an aid in the complex decision making process and provides a framework for compiling clinical and economic evidence in a systematic fashion in a sensible way to reflect the context.

• Alternative to trial based economic evaluation and is widely used, especially in situations where:
  − Lack of well-designed prospective, randomized, pragmatic cost-effectiveness studies that address the specific decision-in-need.
  − A single trial might not compare all the available options, provide evidence on all relevant inputs, or be conducted over a long enough time to capture differences in economic outcomes (or even measure those outcomes).
  − Reliance on a single trial may mean ignoring evidence from other trials, meta-analyses, and observational studies.
## Decision analytic modeling in HTA

### Decision Problem

<table>
<thead>
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<th><strong>Step 1: Specifying the decision problem</strong></th>
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<td><em>Policy Problem</em> → <em>Decision Problem</em></td>
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- Target population(s)
- The local context in which the technology will be used
- Defining options under evaluation
- Stakeholders/Institutions relevant to the decision making process
Step 2: Defining Model Boundaries

“Models are simplifications of reality”

- Specify consequences/outcomes which can be modeled.

- This process is informed by the availability and quality of clinical evidence to inform the treatment effect.
Decision analytic modeling in HTA

Step 3: Designing Model Structure

*Reflect the underlying biological & clinical process in the model structure.*

Key questions to consider:

- Chronic vs Acute disease?
- Does the risk of clinical events change over time?
- Does patient history matter?
- How was this clinical condition modeled before?
Models can be complex OR relatively simple
Step 4: Model Parametrization

*Bring together all relevant evidence given the model structure*

- Systematic identification of relevant evidence
- Clinical Evidence: synthesis where appropriate (ITC, NMA)
- Costing: Micro-costing vs. macro-costing
Decision analytic modeling in HTA

Step 5: Uncertainty

Uncertainty is present in all economic evaluations

- Apply appropriate methods to quantify the degree of uncertainty
- Probabilistic models addressing parameter & decision uncertainty
Decision analytic modeling in HTA

Use the modelling infrastructure to conduct additional analyses:

- What is the budget impact of adopting this new technology?
- Is it cost-effective to invest in more research given the specific policy question under evaluation?
Evidence synthesis for economic model

• The quality of evidence that goes into the model can have a profound effect on the output of the model
Important consideration for evidence

• The care pathway
  – The care pathway is useful to map out the journey of the patients and identify important outcomes that would change the trajectory of the patients.

• Type of outcomes
  – Prediction capability (e.g. Clinical outcomes vs. Surrogate outcomes)
  – Duration of observation (e.g. KM curve extrapolation)

• Hierarchy of evidence for main/primary treatment effect
  1. Systematic reviews (AMSTAR-2)
  2. RCTs (Cochrane Risk of bias tool 2.0)
  3. Comparative observational studies (Down and Black checklist, SIGN)
  4. Expert opinions
Overview

• When building an economic model, it’s important to consider the quality of evidence that goes into the model
  – GRADE, RoB

• Use care pathway to identify important outcomes along the pathway (e.g. outcomes that can predict future events which changes the trajectory of the patients)

• Plan the economic analysis according to the quality of evidence and RoB

• Use risk of bias assessment to plan sensitivity analysis of the model
Reviewing economic models

• Consideration of data inputs, model structure and both internal and external consistency

**Note: CHEERS checklist is *not* a critical appraisal tool only a reporting guideline
Summary and impact

- Economic modeling is an important part of the HTA process that ideally has a broad set of social and economic criteria.
- Modeling can be quite complex and usually requires specialized expertise.
- Helpful to work directly with stakeholders early on and have regular check-ins.
- Modeling relies on a sound evidence base; timing and project management paramount.
- Well designed process can directly impact health system decision-making.