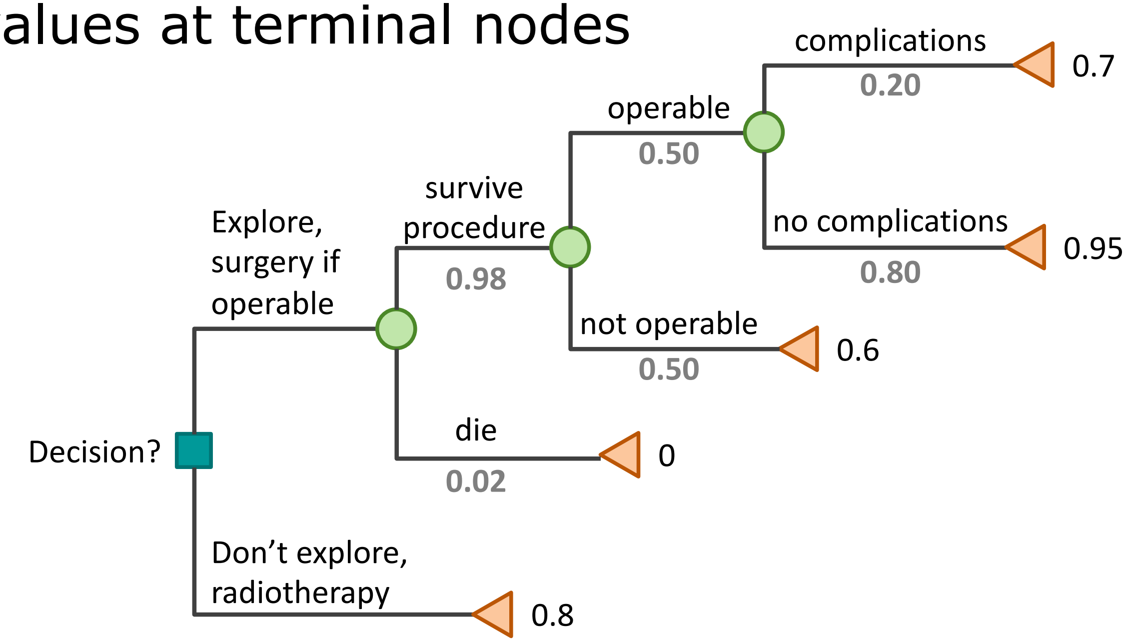
Designing a model-based cost-effectiveness analysis

Decision Modeling for Public Health Workshop

2021 – 2022

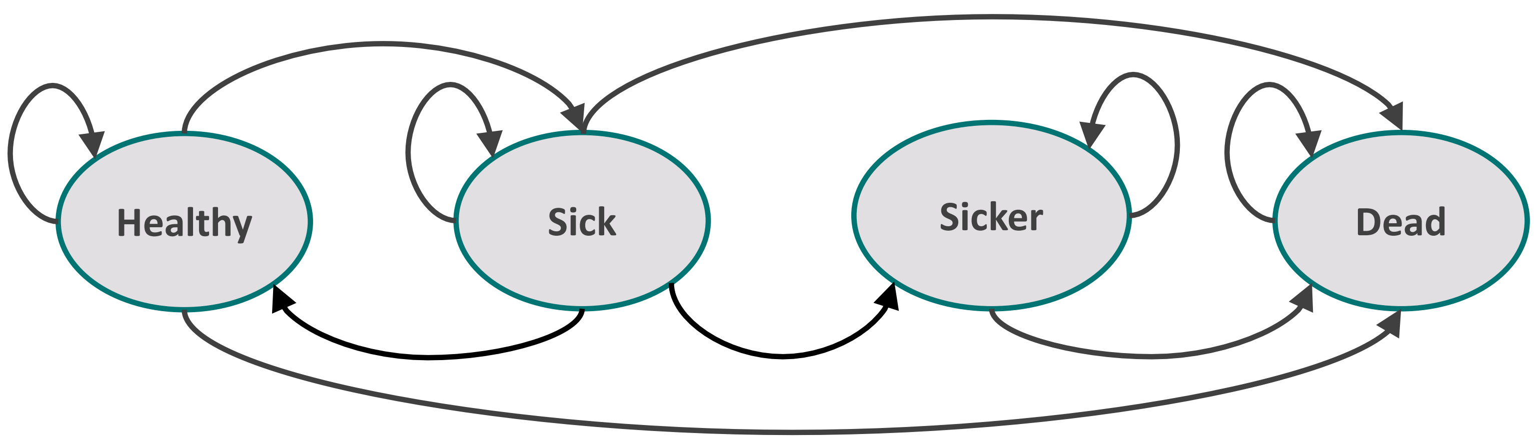
Models Types

- Decision tree
  - Schematic representation of uncertain events/consequences of different alternatives
  - Best for short time horizons
  - Parameterized by branch probabilities and outcome values at terminal nodes



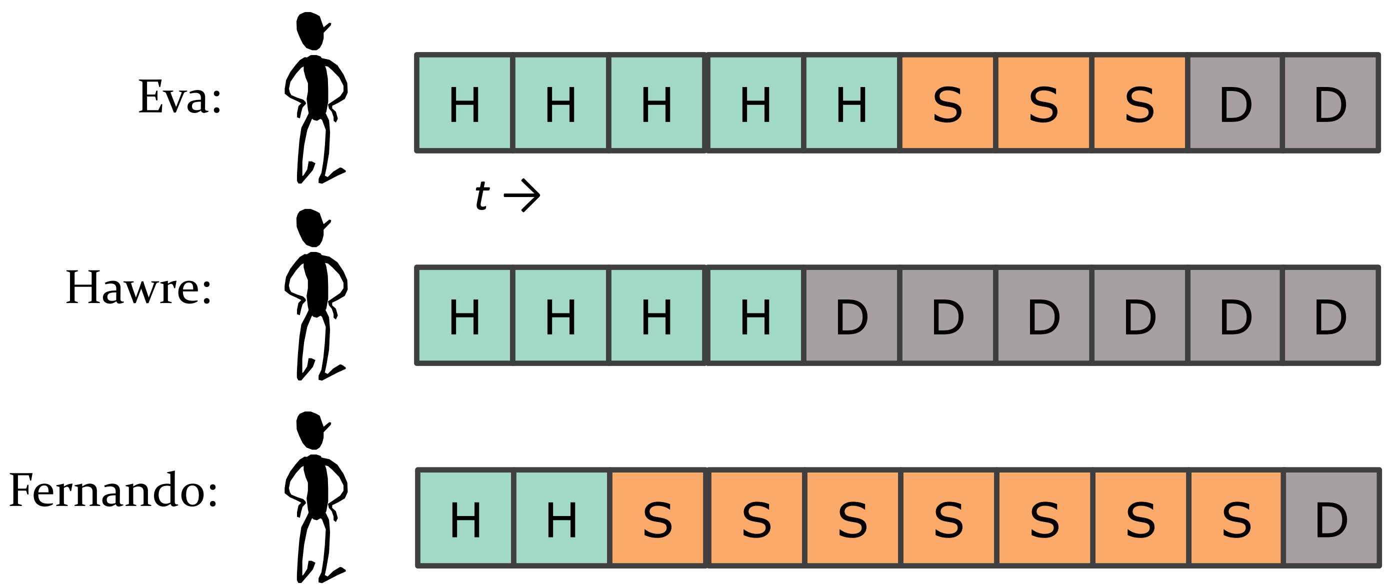
Models Types

- Cohort state transition model
  - Dynamic model that reflects disease progression and other events
  - Models a cohort
  - Set of discrete health states and probability of transitioning between these states



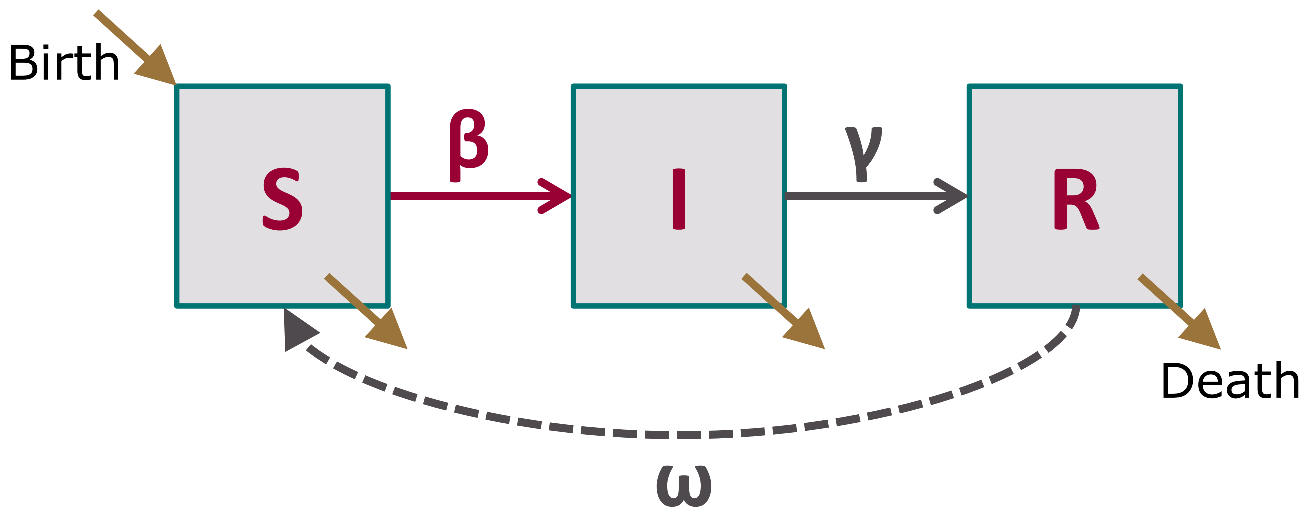
Models Types

- Microsimulation
  - Stochastic dynamic model
  - Models individuals, usually as a closed population
  - Flexible! Can capture complex disease dynamics, including individualized event probabilities, complex history dependence, etc.



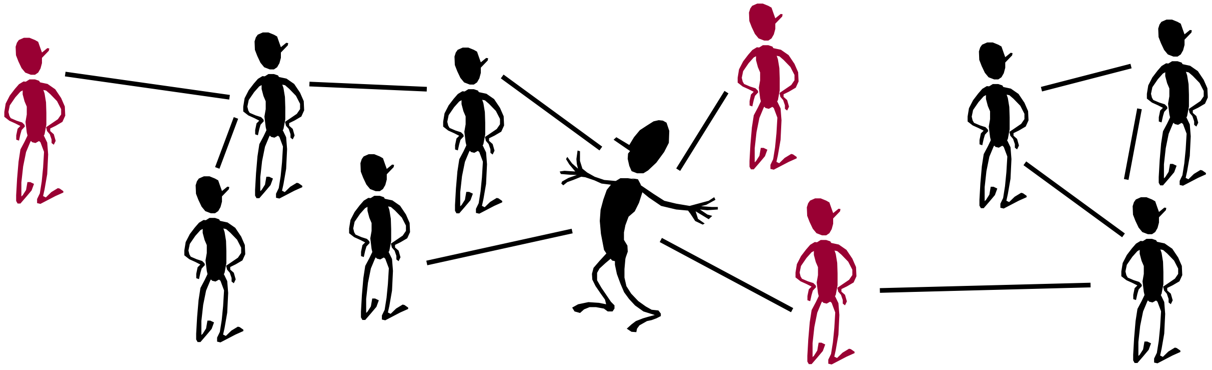
Models Types

- Compartment models
  - Captures transmission of an infectious disease in a population (birth/death)
  - Set of discrete health states
  - Often modeled as differential equations (transition rates between states), but can also use difference equations (transition probabilities)



Models Types

- Agent-based models
  - Captures transmission of an infectious disease in a population (birth/death)
  - Individual-based, same strengths / challenges as microsimulation models
  - Models transmission through specific agent interactions (e.g. contact network)



Components of a Model-Based CEA

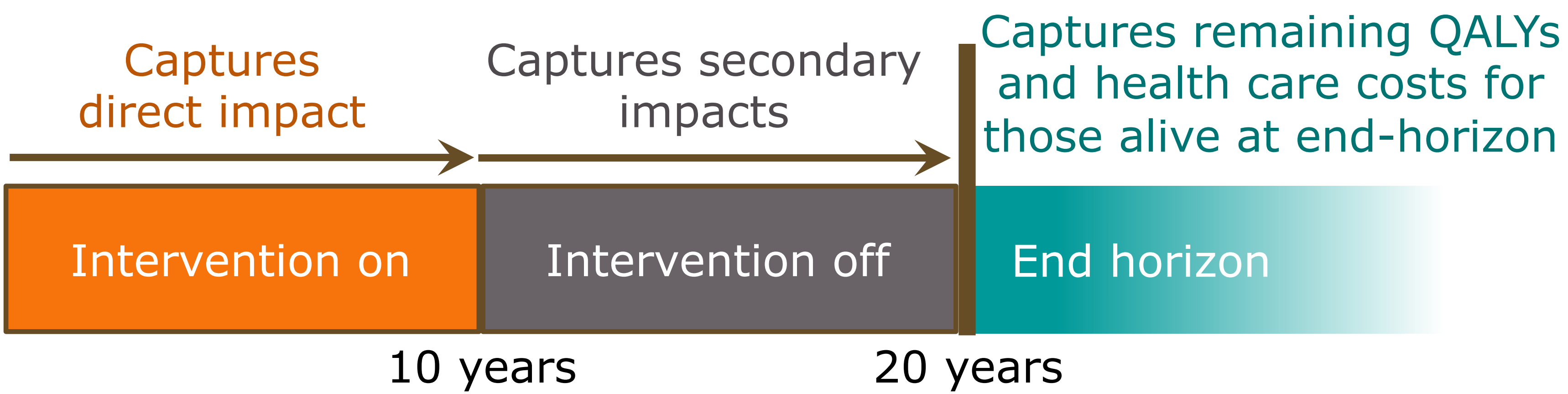
- Use the model to evaluate the costs and benefits of different strategies
- Strategy ← What you are choosing between
  - Clinical guidelines, treatment, new health technology, intervention, program, or policy
  - Consider combinations where relevant
- Costs ← What is included depends on perspective
  - Intervention costs, formal health care costs
  - Informal health care costs, societal costs
- Benefits ← Benefit depends on decision criteria
  - Infections averted, cases averted, disease-specific metrics
  - Life-years saved, quality-adjusted life-years saved

Decision criteria

- How will you decide which strategy is optimal?
- Cost minimization
  - Strategy with lowest cost is optimal
  - Benefit is measured only in terms of averted costs (usually health care costs)
- Cost-effectiveness analysis
  - Strategy that maximizes health gains at a ”reasonable” cost is optimal
  - “Reasonable cost” means less than a cost-effectiveness threshold
  - Cost per QALY gained, cost per life-year gained, cost per infection/case averted

Time horizon

- Time frame over which costs and benefits will be aggregated
- Sufficiently long to capture strategy impacts
- Cohort / closed population: Generally, use lifetime
- Population models: need to define



Modeling costs and QALYs

- Assign cost and utility to each health state
  - Reflects the cost and utility of spending one timestep in a given health state
- Potential to associate costs and/or utility impacts with specific transitions as well
  - "Transition rewards"
- May need additional health states to capture heterogeneity in costs and utilities

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