

# Survival analysis in decision modeling

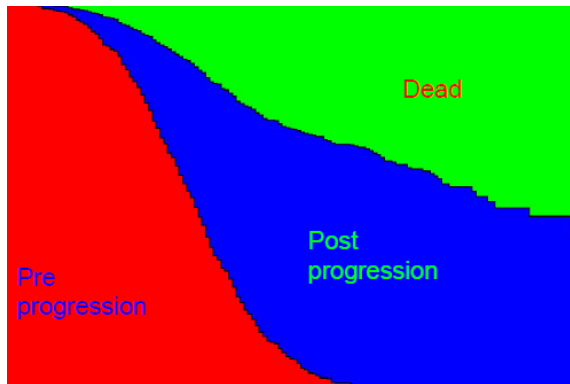
## The DARTH Workgroup

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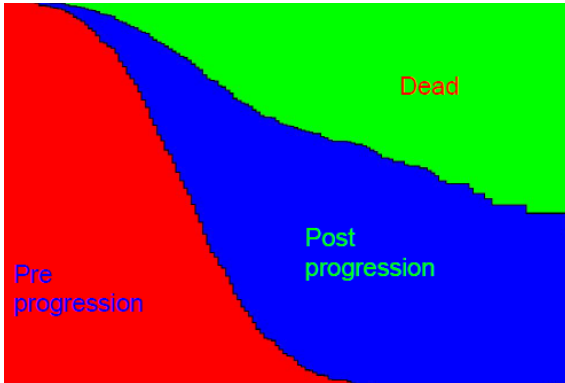
# Partitioned survival models

- ▶ Form of a decision model that:
  - ▶ Considers evidence of (usually) OS and PFS
  - ▶ allocates the cohort across pre-progression, post-progression, death
- ▶ PFS and OS are modeled independently



# Partitioned survival models

- ▶ Mechanics:
  - ▶ Remain pre-progression:  $p(\text{PFS})$
  - ▶ Remain dead:  $1 - p(\text{OS})$
  - ▶ Progressed:  $p(\text{OS}) - p(\text{PFS})$
- ▶ Implicit assumption: risk of dying is only a function of time



Less problematic with less censoring

## Partitioned survival models - the upside

- ▶ Intuitively appealing
- ▶ Easy to communicate
- ▶ Easy to construct
- ▶ In-sync with what is commonly reported in RCTs
- ▶ Can be constructed using aggregate / graphic based data
- ▶ In-sync with methods of cross-over
- ▶ PSMs work great for cases where the whole cohort is observed until event of interest (unlikely in the vast majority of the cases)

## Partitioned survival models - the downside

- ▶ OS and PFS are falsely assumed independent
- ▶ Cohort cannot transition back to a healthier state.
- ▶ 3-state PSM cannot distinguish the origin of the cohort moving to the dead state (progressed  $\rightarrow$  death vs preprogression  $\rightarrow$  death)
- ▶ In the presence of censoring:
  - ▶ Projected trajectory of state occupancy after end of follow up only informed by the observed trajectory
  - ▶ Poor performance when trends in the within trial period may not continue in the extrapolation period



# Partitioned survival models - the criticism

Woods et al 2017 (DSU 19)

## **NICE DSU TECHNICAL SUPPORT DOCUMENT 19: PARTITIONED SURVIVAL ANALYSIS FOR DECISION MODELLING IN HEALTH CARE: A CRITICAL REVIEW**

REPORT BY THE DECISION SUPPORT UNIT

2 June 2017

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Williams et al 2017 (MDM)

MEDICAL DECISION MAKING/MAY 2017

ORIGINAL ARTICLE

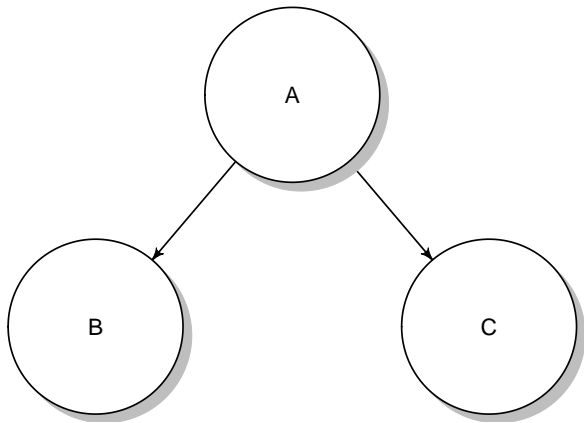
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**Estimation of Survival Probabilities for Use  
in Cost-effectiveness Analyses: A Comparison  
of a Multi-state Modeling Survival Analysis  
Approach with Partitioned Survival  
and Markov Decision-Analytic Modeling**

*Claire Williams, MSc, James D. Lewsey, PhD, Daniel F. Mackay, PhD,  
Andrew H. Briggs, DPhil*

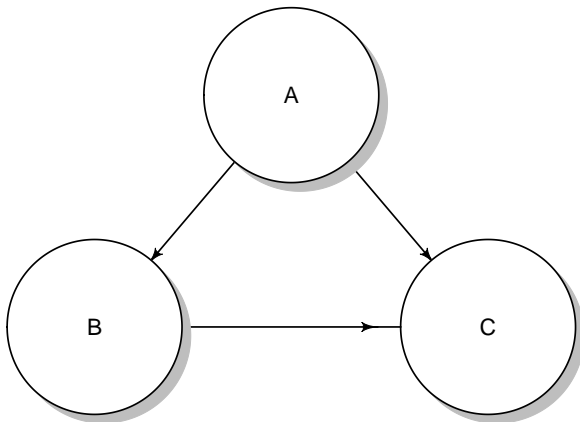
# Competing Risks

- ▶ Underlying assumption in survival analysis:
  - ▶ If we could follow censored individuals long enough they would experience the event of interest.
- ▶ Event B (progression) affects population size at risk for the competing event C



## Multistate modeling

- ▶ Extended form of competing risks
- ▶ Multivariate survival analysis



# Multistate modeling

- ▶ Extended form of competing risks
- ▶ Multivariate survival analysis
- ▶ Can incorporate:
  - ▶ Transition specific covariates
  - ▶ Recurrent events
- ▶ Can work with
  - ▶ Patient-level data (best)
  - ▶ Digitized / interval censored data (... not best)