# Survival analysis in decision modeling

The DARTH Workgroup

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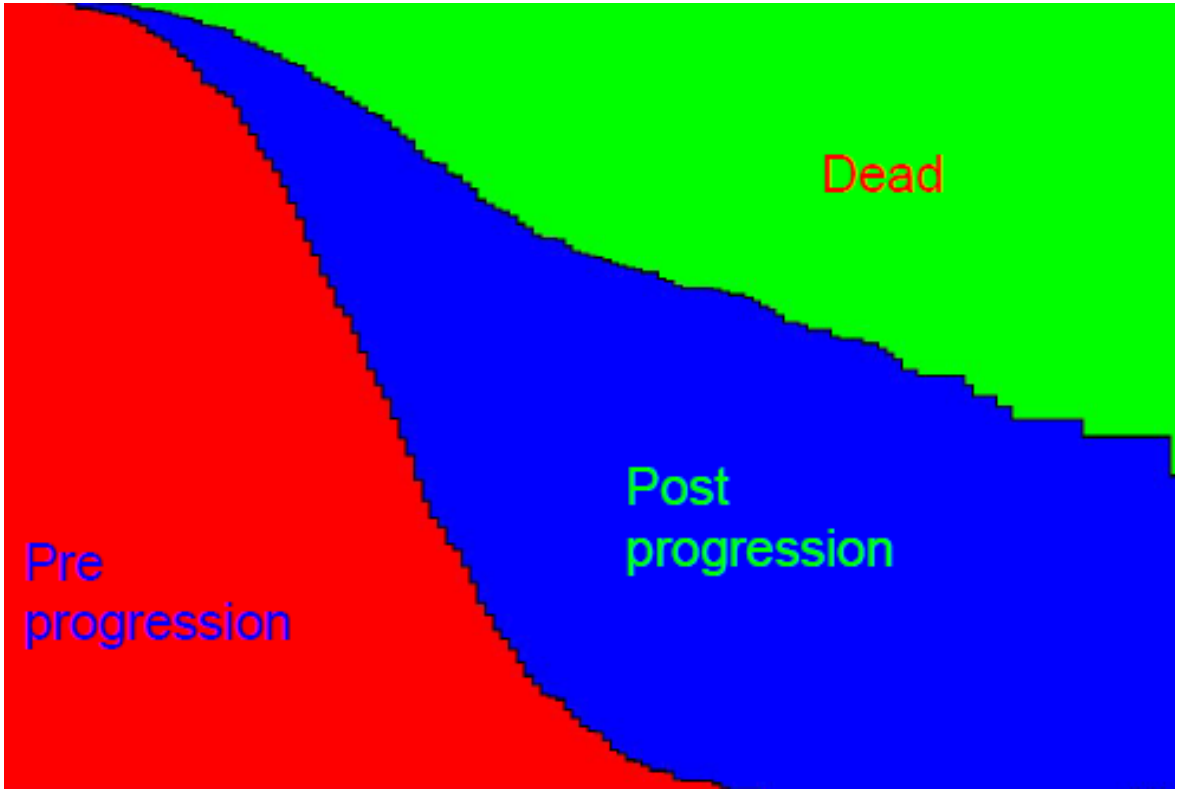
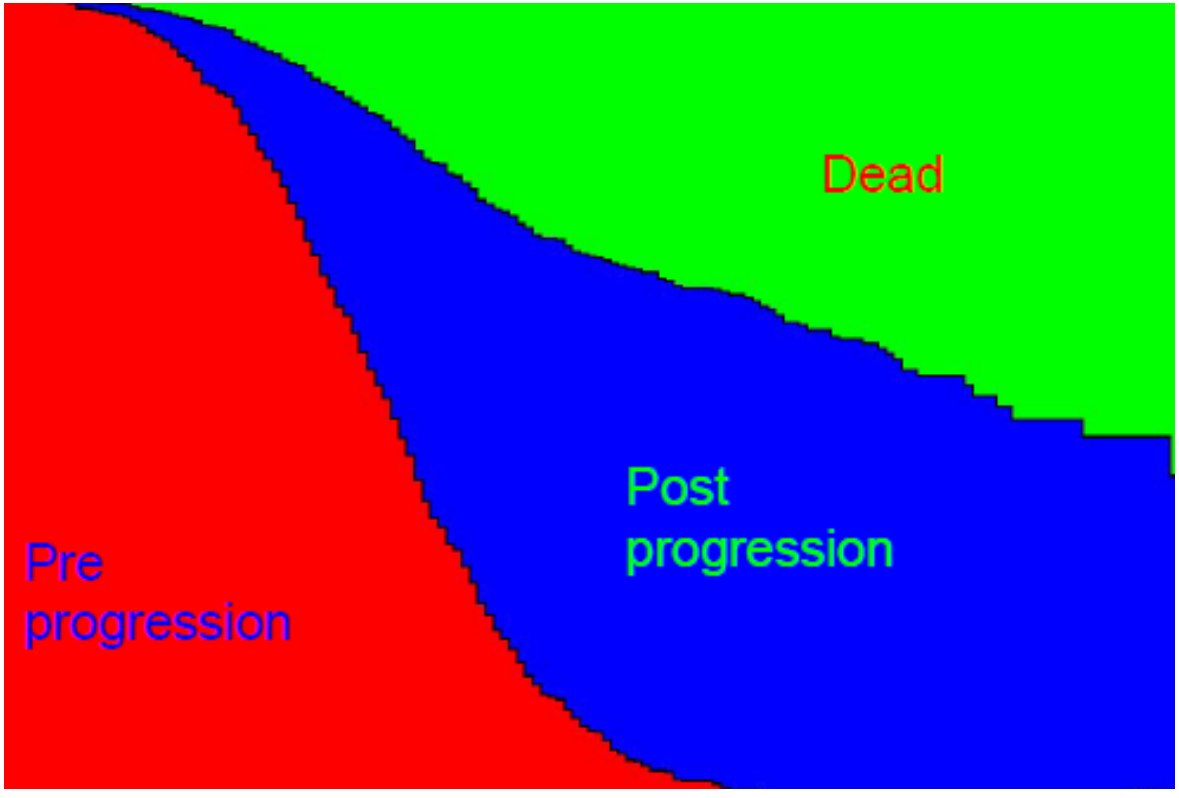
# Partitioned survival models

- 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


Dead
Post
progression
Pre
progression

# Partitioned survival models

- Mechanics:
  - Remain pre-progression: p(PFS)
  - Remain dead: 1 – p(OS)
  - Progressed: p(OS) - p(PFS)
- Implicit assumption: risk of dying is only a function of time




Less problematic with less censoring

# Partitioned survival models - the updside

- 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 (progresed -> death vs preprogession -> 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)

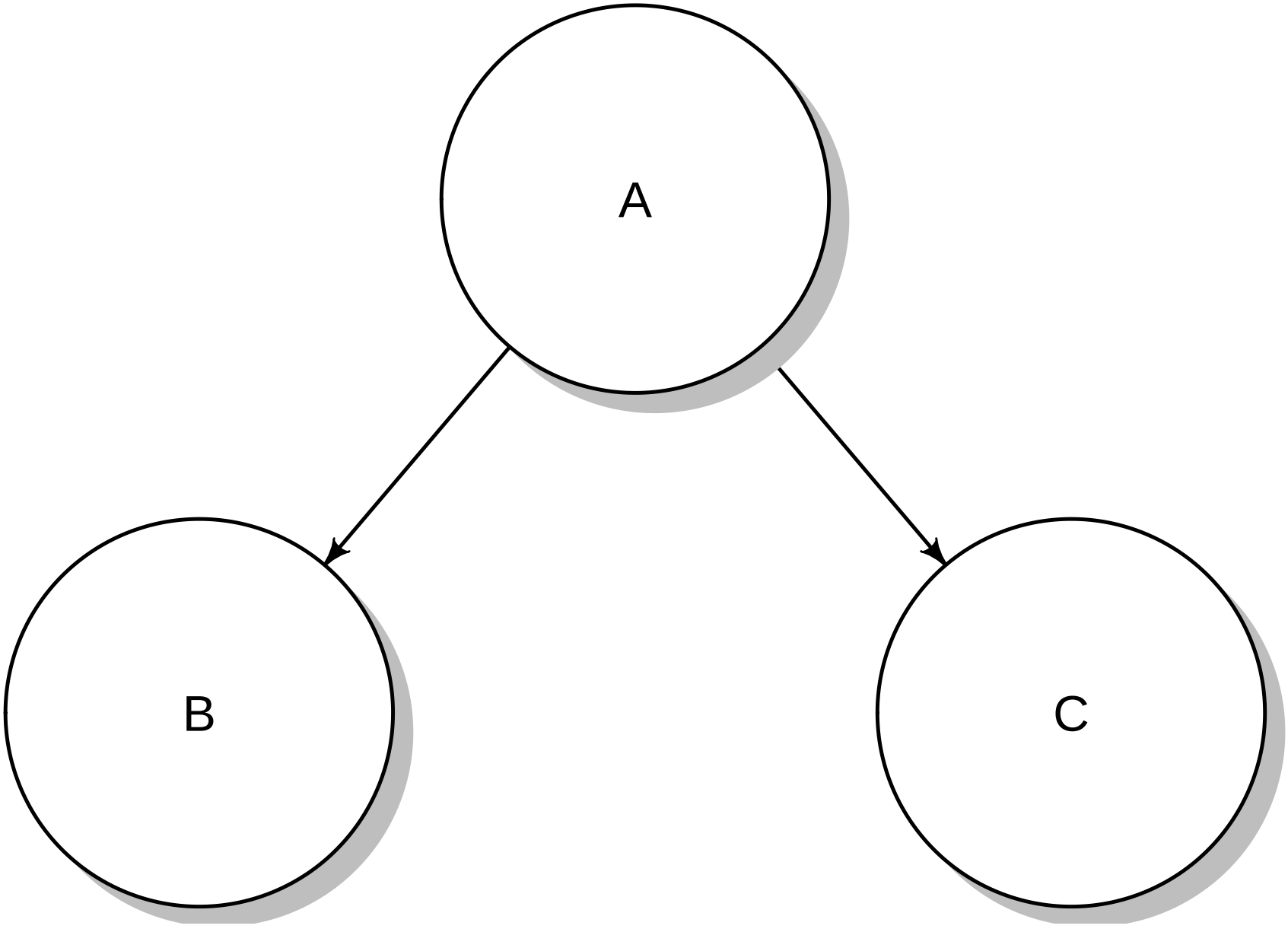
MEDICAL DECISION MAKING/MAY 2017 ORIGINAL ARTICLE

# 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*

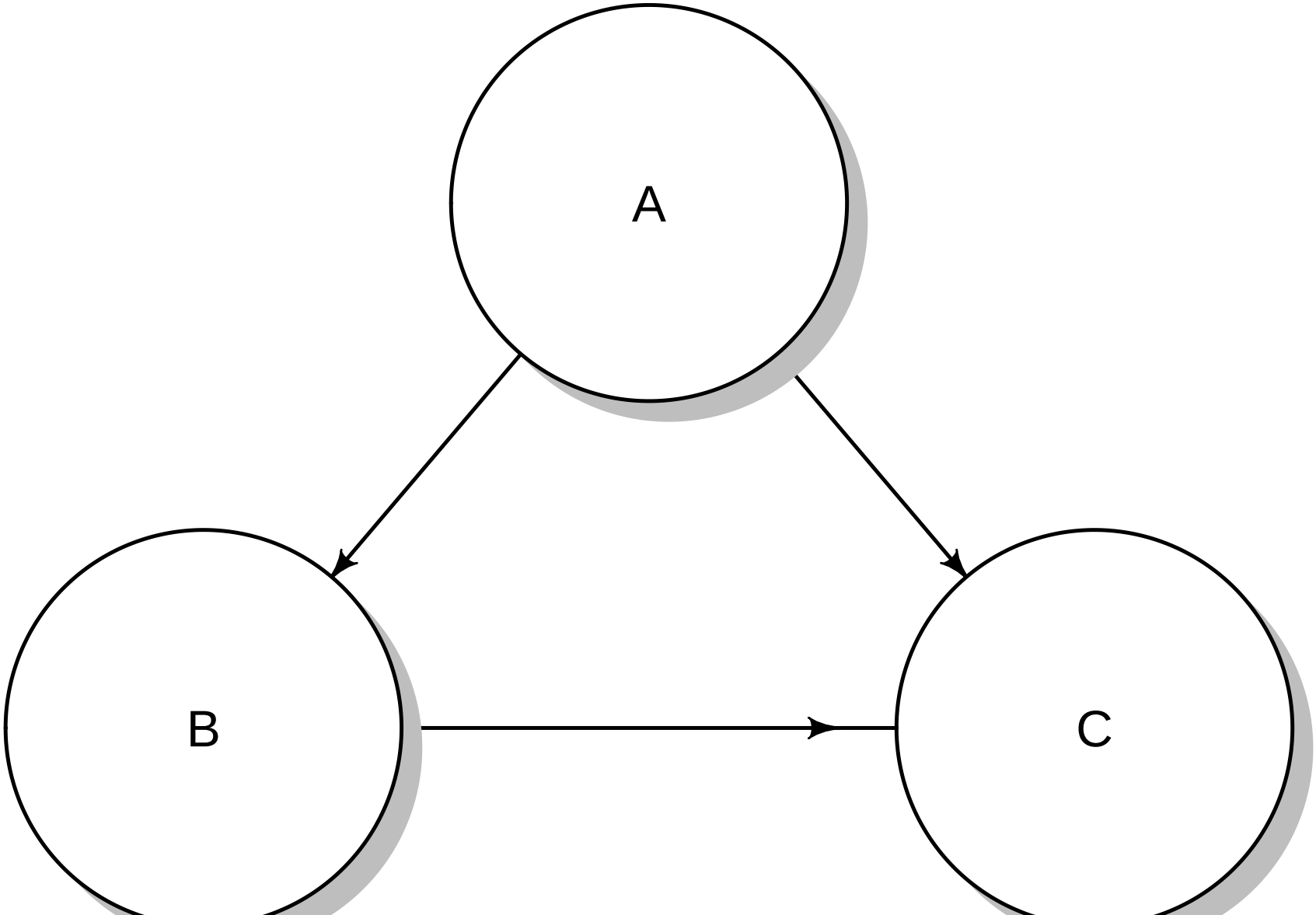
# Competing Risks

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


A
B
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)