
Proceedings Paper:
Bullement, A. orcid.org/0000-0001-7091-0972, Cranmer, H. and Shields, G. (2019) PCN106 A review of decision analytic models to evaluate the cost-effectiveness of cancer treatments : 5-years of publications and single technology appraisals. In: Value in Health. ISPOR Europe 2019, 02-06 Nov 2019, Copenhagen, Denmark. Elsevier BV , S456-S457.

https://doi.org/10.1016/j.jval.2019.09.303

PCN106

A Review of Decision Analytic Models to Evaluate the Cost-Effectiveness of Cancer Treatments: 5-years of Publications and Single Technology Appraisals

Bullement A[1], Cranmer H[2], Shields G[3,4]

[1]Delta Hat, Nottingham, UK; [2]Takeda UK, High Wycombe, UK; [3]University of Manchester, Manchester, UK; [4]Azurite Research, Sheffield, UK.

Background

- As demand for treatment grows and healthcare budgets remain finite, decision makers require the results of cost-effectiveness analysis to make informed decisions in relation to the reimbursement of new cancer treatments
  - In the United Kingdom, cost-effectiveness analyses are routinely submitted to health technology assessment (HTA) agencies, such as the National Institute for Health and Care Excellence (NICE) in England and Wales, and the Scottish Medicines Consortium (SMC)
    - As of May 2019, NICE have published 264 technology appraisals on cancer drugs, which have resulted in 327 individual recommendations on cancer drugs[1]
    - Cancer drugs make up 45.8% of all published technology appraisals carried out by NICE, and 36.7% of all individual recommendations made[1]
- In company submissions of cost-effectiveness analyses for cancer treatments, a variety of different modelling approaches have been utilised to date
  - In June 2017, the NICE Decisions Support Unit (DSU) published Technical Support Document 19, which presented a critical review of partitioned survival analysis (PartSA) for decision modelling in health care[2]
  - The review found that of the 30 cancer appraisals considered, PartSA was used in 22 (73%) of the appraisals[2]
- Since publication of NICE DSU TSD 19, there have been many more submissions of cancer drugs to NICE, as well as other published cost-effectiveness analyses in peer-reviewed publications
  - This study was conducted to summarise the key modelling approaches used to show cost-effectiveness in oncology, as well as their advantages and limitations
  - We expanded on the scope of the review conducted to inform NICE DSU TSD 19 to include other published studies (i.e. not just NICE appraisals) to understand if there were any differences between analyses used to inform HTA submissions to NICE versus those published as research

Objectives

- To identify which model structures are most frequently used to inform submissions to NICE and published cost-effectiveness studies
- To understand the reasons behind the selection of a given model structure, based on the rationale provided by the author(s)

Methods

Identification of studies

- We conducted a review comprising of two components
  - First, we identified single technology appraisals (STAs) submitted to the NICE by searching the NICE website (www.nice.org.uk)
  - Following this, we undertook a systematic search using Medline and EMBASE via Ovid to identify published economic evaluation of cancer treatments using a model
- Searches were performed in November 2018, capturing relevant publications and STAs published since 2013 up to the date of searching
- Inclusion criteria are described in **Table 1**

Table 1. Inclusion criteria

Criterion	Requirement for inclusion
Population	People with cancer (no restriction on the type of cancer)
Intervention	Pharmacological interventions aimed at treating cancer (increasing health and length of life). Interventional studies looking at complications of cancer (e.g. treating anaemia or infections), surgical interventions and precision medicine-focused studies were excluded
Comparator	Comparison with any active intervention, usual care, best supportive care or palliative care
Methods	Studies were required to report the development and use of a decision-analytic model. Multiple technology and highly specialised technology appraisals were excluded
Outcomes	Full economic evaluations (cost-effectiveness or cost-utility studies)
Other	Journal articles published in English language from 2013 up until November 2018. Full-text articles (excluding protocols, case reports, conference proceedings or discussion pieces) were included from the published literature. STAs were included if the necessary documents were available via the NICE website. Publications were excluded if they described the findings of a NICE technology appraisal, or were highlighted within the publication as a country adaptation of a pre-existing published model or NICE STA

Reporting of findings

- Identified studies were reviewed to establish the model structure used
- Model structures were categorised as one of the following:
  - A **PartSA** model (shown conceptually in **Figure 1**)
  - A **Markov state-transition** model (shown conceptually in **Figure 2**)
  - Other
- The author-reported reasons for the model structure used were also extracted and summarised
- Review findings were supplemented with methods literature known to the authors discussing cancer modelling

Figure 1. Concept of the partitioned survival analysis model structure

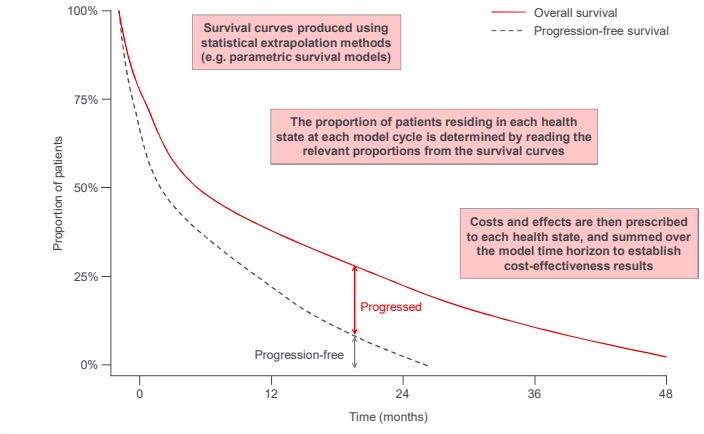
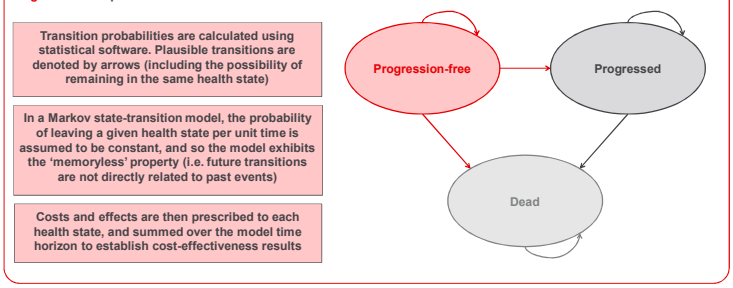


Figure 2. Concept of the Markov state-transition model structure

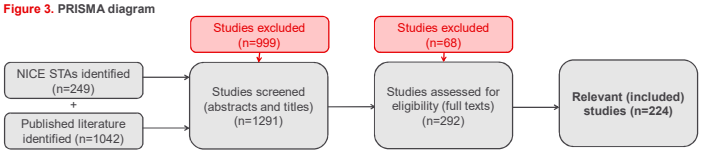


Results

Identified studies

- The screening process is shown in **Figure 3**, the review identified 100 NICE STAs and 124 published studies relevant to the topic

Figure 3. PRISMA diagram



Model structures used

- The model structures used within identified studies are reported in **Table 2**
- Published studies appeared to report a greater use of discrete-time state transition-models (n=102, 82%) when compared to NICE submissions
- Partitioned-survival analysis (n=54, 54%) and discrete-time state-transition structures (n=41, 41%) were the main structures submitted to NICE

Table 2. Model structures used in NICE submissions and published studies

	NICE, n (%)	Published studies, n (%)
PartSA	54 (54%)	15 (12%)
Markov state-transition	41 (41%)	102 (82%)
Other	5 (5%)	7 (6%)
Total	**100**	**124**

Key: PartSA, partitioned survival analysis.

Justification of model structures

- Justification of model structures and consideration of structural uncertainty were very limited within publications; a minority of published studies (22%) reported any strengths or limitations associated with the chosen model structure
- The NICE STAs typically included more discussion on model choice (a requirement of the submission template)
  - Justification was most often based on case precedence and ability to incorporate data from the trial or literature directly
  - The ERGs rarely commented on the merits of the companies' submitted model structures. Criticisms raised by ERGs in relation to the model structure used by the company included the lack of calibration between outcome measures, an 'over-simplification' of the final health state, seemingly 'counterintuitive' results and structural assumptions that were considered 'inappropriate'

Conclusions

- There appears to be a stronger dominance of the partitioned-survival analysis approach in submissions to NICE, however, we believe many of the published state transition models have been incorrectly labelled and are partitioned-survival analysis
  - There is a clear need to improve the reporting of modelling structures within the published literature, especially when considering recent developments in modelling methods which may introduce further complexity in describing model structures used
- Other structures, such as a decision tree or discrete-event simulation, have also been utilised in submissions and within the published literature but only in minority of cases
  - This finding is perhaps unsurprising as a key finding of the review was that model structures were often justified by citing case precedence. However, it is our opinion that this should not be considered a sufficient basis to determine the preferred model structure
- The justification for a given model structure was very limited within the identified studies, despite a recognition in the literature that model structure can greatly influence cost-effectiveness results
  - The validity of the cost-effectiveness analyses presented in HTA submissions or published literature would be greatly improved if presented with a thorough rationale for the choice of model structure
  - In addition, with improved documentation of the choice concerning model structures, future research may be better informed as to the decisions made to inform previous analysis, and whether or not the stated rationale is still applicable

References

1. National Institute for Health and Care Excellence (NICE). Technology appraisal data. 2019. Available at: https://www.nice.org.uk/about/what-we-do/our-programmes/nice-guidance/nice-technology-appraisal-guidance/data. Last updated: 2 May 2019. Accessed: 26 September 2019.
2. Woods B, Sideris E, Palmer S, Latimer N, Soares M. NICE DSU Technical Support Document 19. Partitioned Survival Analysis for Decision Modelling in Health Care: A Critical Review. 2017. Available at: http://www.nicedsu.org.uk. Last updated: 2 June 2017. Accessed: 26 September 2019.

Full paper available (open access)

Bullement A, Cranmer HL, Shields GE. A Review of Recent Decision-Analytic Models Used to Evaluate the Economic Value of Cancer Treatments. Appl Health Econ Health Policy. 2019 Sep 4.

Abbreviations

PartSA, partitioned-survival analyses; HTA, health technology appraisal; STA, single technology appraisal.

Acknowledgments

The authors received no specific funding for this work and declare that they have no conflict of interest.