A Comparison of Three and Four State Economic Models for Cost-Effectiveness Analysis in Oncology

Devin Incerti[1,2], Jeroen Jansen[1,2]

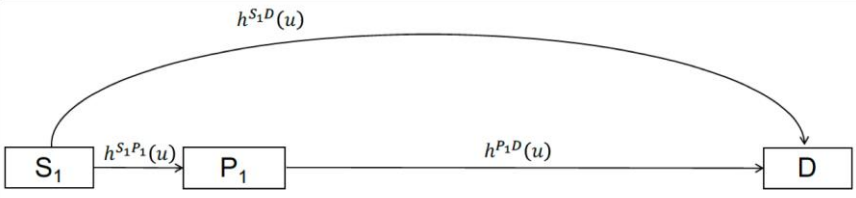
[1]Innovation and Value Initiative

[2] Precision Health Economics

Overview

- Cost-effectiveness analyses in oncology are typically based on model structures with 3 health states (stable disease, progressed disease, and death)
- But 3-state models do not explicitly incorporate 2L treatments
- We developed a model for NSCLC (the IVI-NSCLC model) that can simulate different model structures in a multi-state framework
  - 3-state models
  - 4-state models explicitly incorporating 2L treatments
- Differences in cost-effectiveness results between the 3- and 4-state models were compared

3-state model



S_1= Progression-free (stable disease) with 1L treatment

P_1= Progression with 1L treatment, captures the survival with 2L and 2L+ without making a distinction between progression free and progression phases

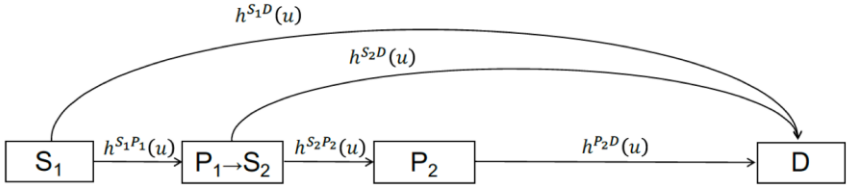
D= Dead

$h^{S_1P_1}(u)$= hazard for transitioning from progression-free to progression with 1L treatment at time u

$h^{S_1D}(u)$= hazard for transitioning from progression-free to dead with 1L treatment at time u

$h^{P_1D}(u)$= hazard for transitioning from progression on 1L to dead at time u

4-state model



S_1= Progression-free (stable disease) with 1L treatment

P_1= Progression with 1L treatment

S_2= Progression-free (stable disease) with 2L treatment

P_2= Progression with 2L treatment, captures the survival with 2L+ without making a distinction between a progression free and progression phase

D= Dead

$h^{S_1P_1}(u)$= hazard for transitioning from progression-free to progression with 1L treatment at time u

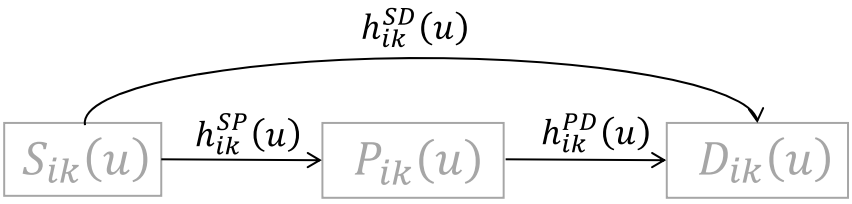
$h^{S_1D}(u)$= hazard for transitioning from progression-free to dead with 1L treatment at time u

$h^{S_2P_2}(u)$= hazard for transitioning from progression-free to progression with 2L treatment at time u

$h^{S_2D}(u)$= hazard for transitioning from progression-free to dead with 2L treatment at time u

$h^{P_2D}(u)$= hazard for transitioning from progression on 2L to dead at time u

Parameterized using multi-state network meta-analysis conducted separately by line (1L, 2L)



$S_{ik}(u)$= progression -free (stable disease) in study i, treatment arm k at time u

$P_{ik}(u)$= progressed disease in study i, treatment arm k at time u

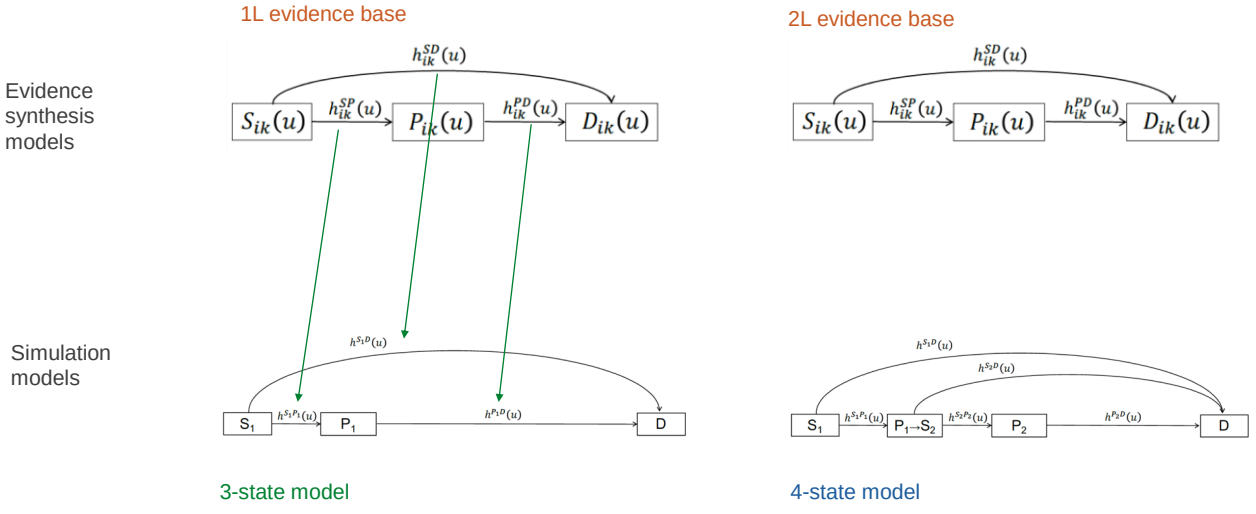
$D_{ik}(u)$= dead in study i, in treatment arm k at time u

$h_{ik}^{SP}(u)$= hazard rate for disease progression in study i, in treatment arm k at time u

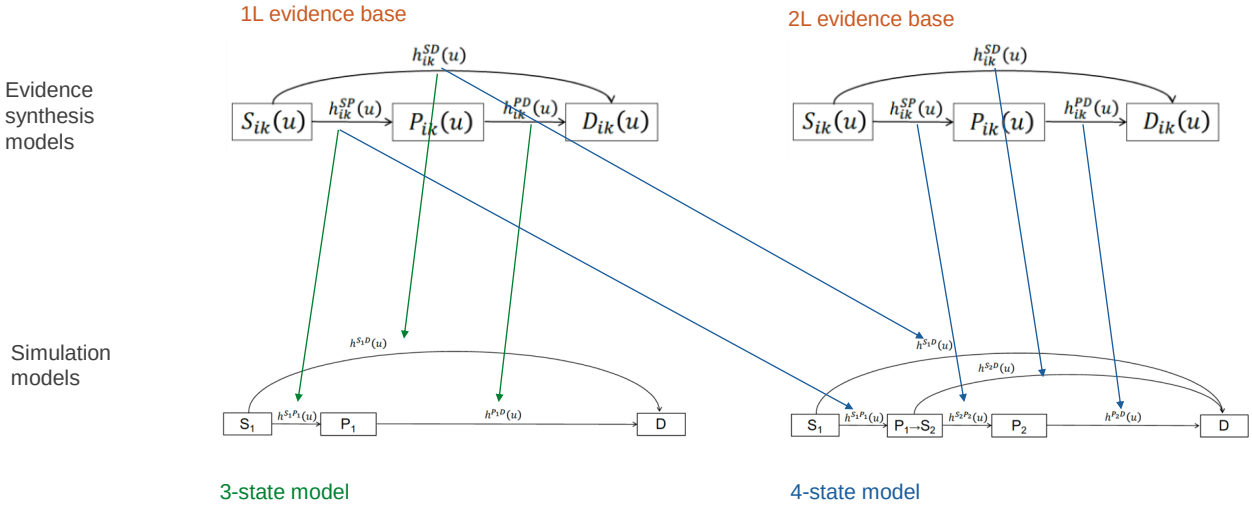
$h_{ik}^{PD}(u)$= hazard rate for dying post-progression in study i, in treatment arm k at time u

$h_{ik}^{SD}(u)$= hazard rate for dying pre-progression in study i, in treatment arm k at time u

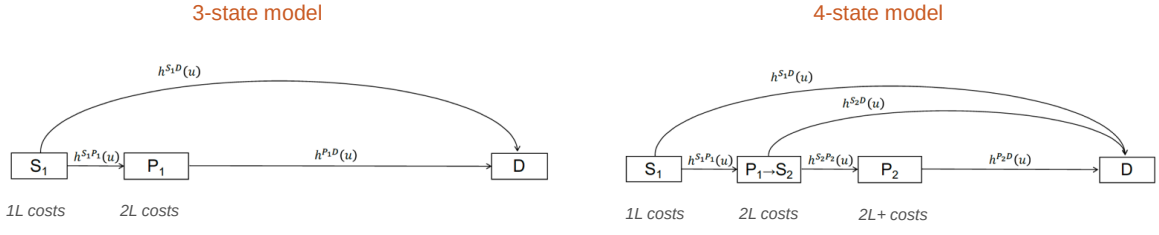
Incorporation of treatment effect parameters



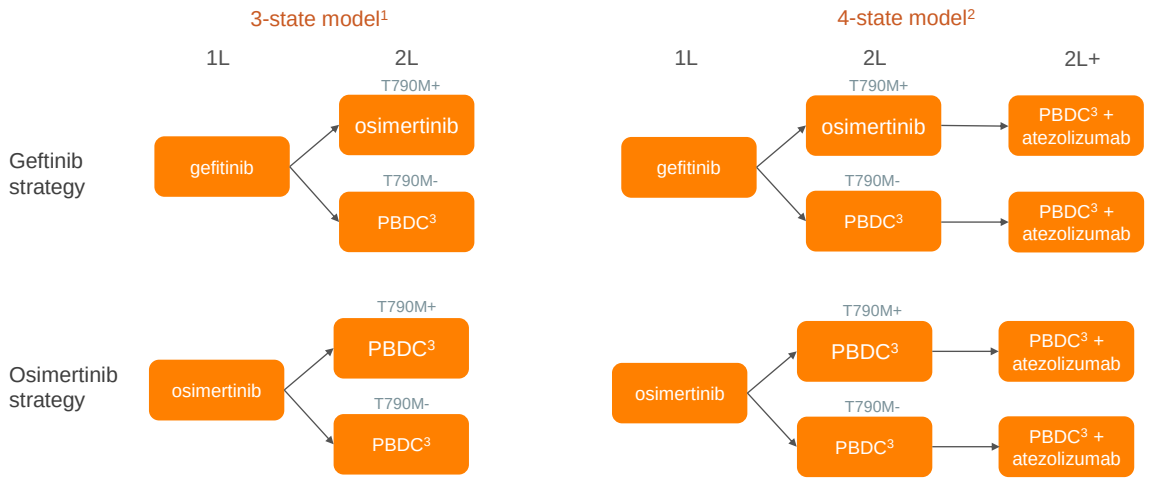
Incorporation of treatment effect parameters



Treatment costs by health state

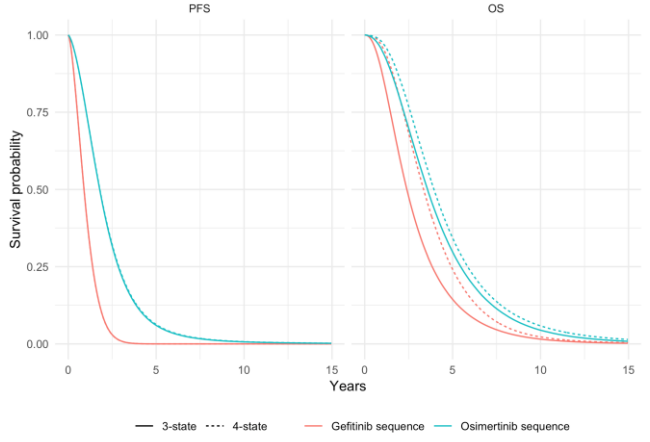


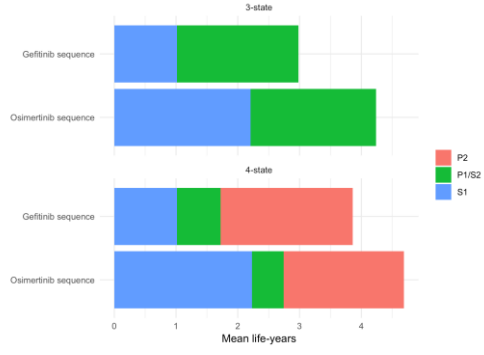
Example analysis



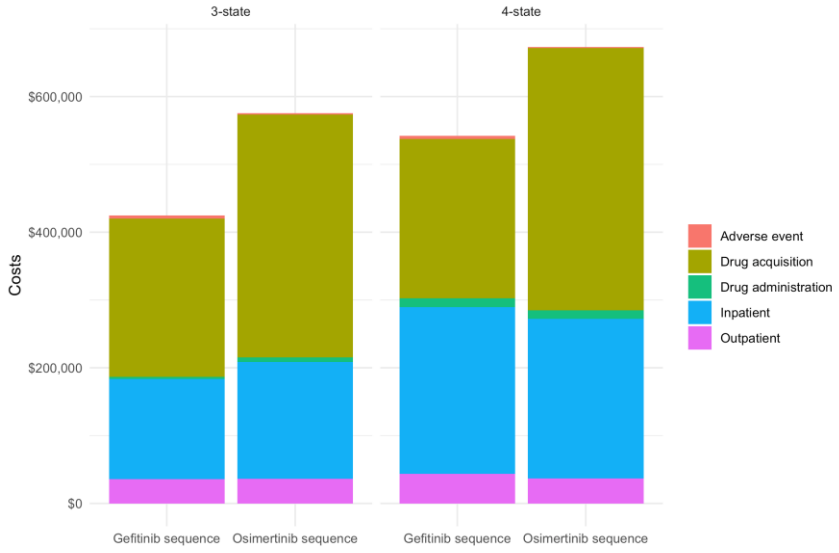
[1] 3-state model: 1L evidence for efficacy; 1L and 2L treatment costs
[2] 4-state model: 1Land 2L evidence for efficacy; 1L, 2L, and 2L+ treatment costs
[3] PBDC = platinum-based doublet chemotherapy

Results: efficacy





Results: costs



Results: cost-effectiveness

	3-state model		4-state model	
	Gefitinib sequence	**Osimertinib sequence**	**Gefitinib sequence**	**Osimertinib sequence**
Incremental QALYs	-	0.82 (0.25, 1.93)	-	0.60 (-0.01, 1.66)
Incremental costs ($)	-	151,009 (27,471, 387,111)	-	131,360 (-2,212, 372,498)
ICER ($ per QALY)	-	184,720	-	220,255

Note: Estimates discounted at 3%. The gefitinib sequence is the reference treatment strategy.

Conclusion

- 2L treatments can have a significant impact on the efficacy of treatment sequences as well as treatment costs
- The differences in efficacy can have impacts on non-treatment related costs such as inpatient costs
- In general, a 4-state model will differ the most from a 3-state model when:
  - 2L and 2L+ treatments differ across the competing treatment sequences
  - 2L and 2L+ treatment costs differ
  - Disease progression is correlated with higher non-treatment costs