Evaluation of the Impact of Survival Costs in Oncology Economic Modelling

Dr Matthew Taylor[1], Alexandra Fllby[1], Clare Proudfoot[2]

[1] **York Health Economics Consortium, Level 2 Market Square, University of York, Heslington, York, YO10 5NH, UK**

[2] **Sanofi. This work was commissioned by Sanofi and Sanofi personnel have been involved in the development of this work .**

Background and Objectives

Economic evaluations typically include all costs relevant to a disease, not only drug-related costs. Since patients often incur higher healthcare costs in the post-progressed state of disease where costs of disease management are high, extending survival and increasing a patient's time in the post-progressed stage can be particularly costly. In some cases this can be prohibitive to an intervention's likelihood of being cost-effective. Empirical analyses of the implications of such methods have not yet been extensively investigated by assessing different scenarios such as baseline severity and prognosis.

The objective of this research was to investigate the cost-effectiveness implications of improved survivorship, and to determine the effect that this has on predicted cost-effectiveness by:

- Developing a flexible three-state model to allow investigation of the modelling methodology;
- Reviewing published literature to determine model inputs;
- Carrying out extensive scenario and multi-way sensitivity analysis to investigate the effects of varying multiple parameters within the model on the overall results.

Methods

A flexible three state model was developed (see Figure 1) with 10 core parameters using a standard oncology modelling approach. In order to allow multiple parameters to be varied at one time, a method of presenting four-way sensitivity analysis, which allows four parameters to be varied simultaneously while presented in a readable and user-friendly way, was developed (see Figure 2). The four-way sensitivity analysis consists of nine graphs presented in a grid format. Figure 2 shows an example of one of the nine graphs. The full nine graph layout is shown in Figures 4 and 5. The four parameters that are varied in these examples are pre-progression monthly drug cost, post progression utility, overall survival hazard ratio and post-progression background costs. Presenting the results in this format allows the results to be read horizontally and vertically along the graphs.

Figure 1: Model structure

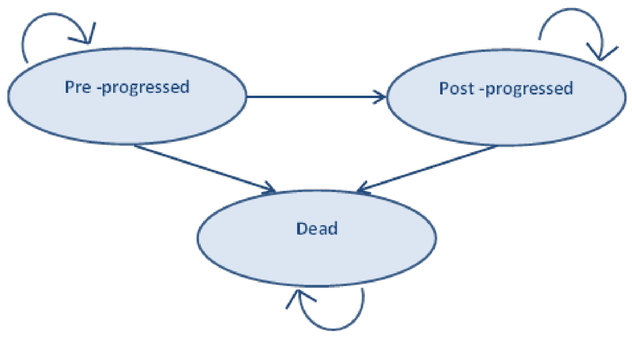
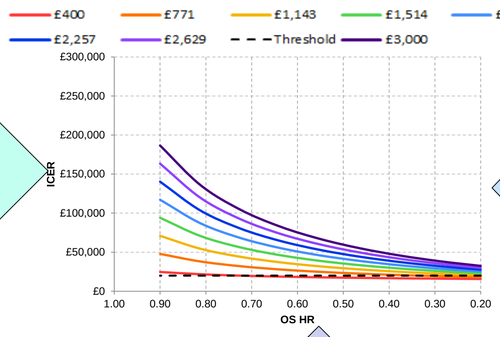


Figure 2: Sensitivity analysis example



Incremental cost-effectiveness ratio (ICER). The threshold is set at £20,000 which is generally deemed to be cost-effective.

A different curve is shown for each monthly drug cost (using a range defined by a minimum, a maximum and a set number of increments). In this example, where the drug cost is higher, the ICER is also higher (less cost-effective).

In this example, as the overall survival hazard ratio (HR) is decreased (i.e. survival is higher) the ICER decreases (more cost-effective).

Results

The 'natural ICER'

The results show that, in each analysis, all curves tend towards a 'natural ICER' as effectiveness (i.e. incremental overall survival) increases. In reality, of course, because effectiveness is finite, the ICER for any given treatment will not necessarily match the 'natural ICER', since other factors will drive the results. It is true, however, that as incremental overall survival increases, the ICER will move towards the natural ICER. This is true no matter what drug cost is applied.

The 'natural ICER' is calculated by: *annual background costs for the post-progression state utility for the post-progression state*

The lower the post-progression cost, the lower the 'natural ICER' will be. In the same way, the lower the post progression utility, the higher the 'natural ICER' will be. The 'natural ICER' (i.e. the point toward which the curves converge) is independent of drug cost. Another way of explaining this is that, the greater the incremental survival, the less weight the drug cost has on the ICER. The 'natural ICER' can be used as a base case to predict whether the ICER will rise or fall as survival is increased.

Key results

Due to the many possible permutations of parameters that can be varied at one time, only the key scenarios that were explored are summarised here.

In this set of comparisons, the time spent in progression-free survival (PFS) was varied while overall survival (OS) remained the same. Figure 3 shows the survival curves in two scenarios in which the time spent in PFS is varied.

Results cont.

The results (Figure 4) show that the larger the proportion of overall survival is spent in PFS, the more spread out the curves are. It is the ratio of time spent in PFS and OS that is key, not the absolute time spent in each state. The results are less fanned out when a larger proportion of time is spent in the post-progressed state (Figure 5) because there is less weight given to the pre-progressed drug costs and more weight on the post-progression background costs (i.e. the 'natural ICER' plays a greater role). This explains why, when the 'natural ICER' is high (i.e. when background costs are high and utility is low) it is highly unlikely that a treatment will be cost-effective because increased survival is penalised by prohibitively high background costs.

Figure 3: Survival curves

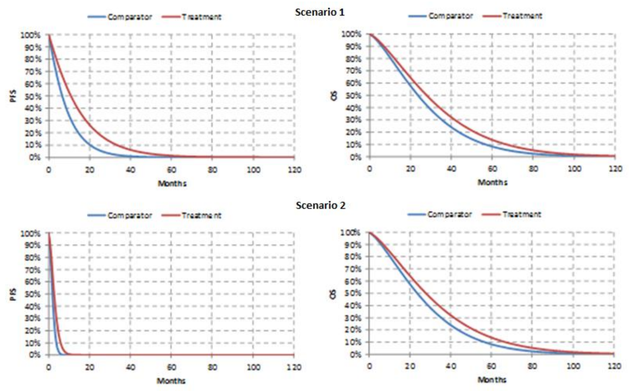


Figure 4: Results: 4-way SA PFS higher proportion

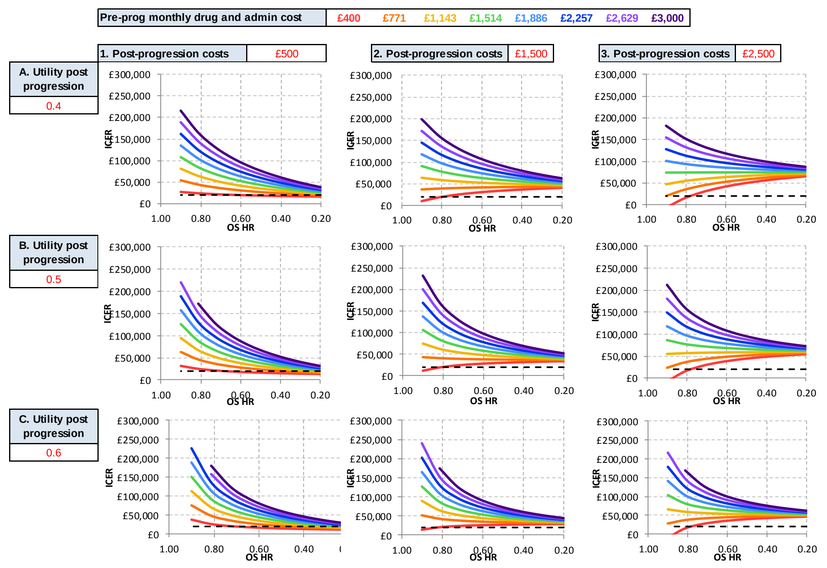


Figure 5: Results: 4-way SA PFS longer

Conclusions

The results demonstrate that when a drug is not cost-effective it is not always due to the price of the drug. In some cases the graphs also show that the greater the efficacy of a drug, the higher the ICER will be. These results are due to the economic nature of the disease (high post-progression background costs and low post-progression utility).

In some cases, it is possible to conclude that no matter what extra survival a drug offers and how low the price is, it will not be cost-effective if the 'natural ICER' is not cost-effective.

Contact Us

matthew.taylor@york.ac.uk
Telephone: +44 1904 323631
Website: www.yhec.co.uk
http://www.minerva-network.com/
http://tinyurl.com/yhec-facebook
http://twitter.com/YHEC1
http://tinyurl.com/YHEC-LinkedIn

Providing Consultancy & Research in Health Economics

THE UNIVERSITY of York

INVESTORS IN PEOPLE

YHEC

York Health Economics Consortium