The key drivers of cost effectiveness in Crohn’s disease

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Objectives

Background
Crohn’s disease is a lifelong inflammatory bowel disease, which is characterised by stages of relapse and remission. Common symptoms include diarrhoea, abdominal pain, fatigue, anaemia and weight loss.1 It is estimated that 1 in every 650 people in the UK suffer from Crohn’s disease. This equates to approximately 154 per 100,000 people.

A published economic model of biological therapies for moderate-to-severe Crohn’s disease was used recently in the National Institute for Health and Care Excellence (NICE) technology appraisal for vedolizumab.2, 3 The model, originally described by Bodger et al., used health states defined by the Crohn’s Disease Activity Index (CDAI) score: remission, mild-to-moderate, moderate-to-severe and surgery.2 This model was recreated for the purpose of this research.

Objective
The objectives of this study were to identify key drivers of cost effectiveness in Crohn’s disease and to identify key similarities and differences of cost effectiveness between the models.

Methods
We recreated the economic model described by Bodger et al. using their data.2 Where information was not available from the publication, or more recent data were available, it was supplemented from documents relating to the NICE appraisal of vedolizumab, in which the manufacturer’s economic model was heavily influenced by Bodger et al.3 Health state costs were taken from Bodger et al. and inflated to 2013/14 values using the Unit Costs of Health and Social Care 2014.4 Treatment costs were taken from the Monthly Index of Medical Specialities (MIMS) treatment costs were taken from the Monthly Index of Medical Specialities (MIMS) and updated to 2013/14 values using the UK Consumer Price Index (CPI). The deterministic incremental cost-effectiveness ratios (ICERs) for infliximab and adalimumab versus standard care obtained from the reconstructed model were compared with the ICERs reported for the published model. Costs and quality-adjusted life years (QALYs) were taken from the vedolizumab submission to derive ICERs versus standard care. A one-way sensitivity analysis (OWSA) of vedolizumab versus standard care was performed in the reconstructed model using the same assumptions as the submission base case, and the outputs of both models were compared to assess whether the key drivers of the models were consistent.

Figure 1: Model structure (adapted from Bodger et al.2)

Response: Enter Markov model on biological therapy
No response: Enter Markov model on standard care

Bodger et al. reported base case ICERs versus standard care of £19,050 for infliximab and £7,190 for adalimumab, respectively.2 In contrast, the reconstructed model reported ICERs of £34,077 and £31,210, respectively. These are similar to the results from the vedolizumab submission model, which gave ICERs of £39,186 and £44,603, respectively, over a 10-year horizon.3 This suggests that the differences in results are principally due to the use of updated efficacy data from the vedolizumab submission, rather than data from the original publication by Bodger et al. Full results are shown in Table 1.

Table 1: Cost-effectiveness results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Costs</th>
<th>Incremental Costs</th>
<th>ICER vs standard care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodger et al. (time horizon 60 years)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Standard care</td>
<td>£43,490</td>
<td>£14,21</td>
<td>£29,279</td>
</tr>
<tr>
<td>Adalimumab</td>
<td>£46,730</td>
<td>14,68</td>
<td>£3,240</td>
</tr>
<tr>
<td>Infliximab</td>
<td>£50,330</td>
<td>14,57</td>
<td>£6,840</td>
</tr>
<tr>
<td>Vedolizumab submission (time horizon 10 years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard care</td>
<td>£45,241</td>
<td>5,02</td>
<td>£7,190</td>
</tr>
<tr>
<td>Adalimumab</td>
<td>£50,415</td>
<td>5,13</td>
<td>£5,177</td>
</tr>
<tr>
<td>Infliximab</td>
<td>£55,800</td>
<td>5,17</td>
<td>£9,233</td>
</tr>
<tr>
<td>Reconstructed model (time horizon 60 (10) years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard care</td>
<td>£139,858 (£52,160)</td>
<td>11,07 (4.15)</td>
<td>£54,474</td>
</tr>
<tr>
<td>Adalimumab</td>
<td>£145,002 (£57,304)</td>
<td>11,23 (4.32)</td>
<td>£5,177</td>
</tr>
<tr>
<td>Infliximab</td>
<td>£150,434 (£62,736)</td>
<td>11,26 (4.35)</td>
<td>£10,576 (£10,576)</td>
</tr>
</tbody>
</table>

Key: ICER, incremental cost-effectiveness ratio; QALYs, quality-adjusted life years.

Figure 2 shows the seven most influential parameters for the cost effectiveness of vedolizumab versus standard care in the reconstructed model. The publication by Bodger et al. did not discuss the key drivers of cost effectiveness.2 The key drivers of the reconstructed model and the vedolizumab submission indicated that these are broadly similar.3 These include efficacy parameters, rates of response and remission during the induction period, in addition to the percentage of responders who remained in the moderate-to-severe health state at the end of the induction period. Health state utilities and mean age were also key drivers in both models. Adverse event (AE) rates for both arms were important in the vedolizumab submission, and standard care rates was the most influential parameter.4 These parameters were not as influential for the reconstructed model.

Induction rates are likely to be influential as 100% of patients on active treatment during this phase. If patients on biological treatment do not respond in this phase, they move to standard care (see Figure 1) meaning fewer patients remain on treatment in the maintenance phase. If patients move into the remission or mild health states, they have a greater probability of staying there than patients who remain in the moderate-to-severe health state. Furthermore, each health state has an associated cost to reflect resource use. The cost of remission and response are lower than other health states, particularly remission, which is around three times lower than response. This is likely the reason moving to these health states, particularly remission, has such a great impact on cost effectiveness. AE rates may be more influential in the vedolizumab submission as these were treated as a group in the OWSA, rather than individually as in the reconstructed model. Standard care rates may be more influential as these apply to more patients, as patients gradually move to standard care.

Figure 2: Tornado diagram: vedolizumab vs standard care from reconstructed model

$100,000 $125,000 $150,000 $175,000

Remission rate of vedolizumab
Remission rate of standard care
Response rate of standard care
Mean age
Response rate of vedolizumab
Percentage of moderate-to-severe responders
Induction probability of surgery

Key: ICER, incremental cost-effectiveness ratio; QALYs, quality-adjusted life years.

Conclusions
The results suggest that differences in ICERs between the reconstructed model and the model by Bodger et al. are possibly due to the use of updated efficacy data. The reconstructed model and the model used for the vedolizumab submission to NICE used the same efficacy data and had similar base case results; while the model by Bodger et al. used different and older efficacy analysis and gained very different results.3 2 The results of the OWSA suggest that rates of response, remission and AEs are important drivers of cost effectiveness in Crohn’s disease. Overall, efficacy data in terms of the rates of response and remission appear to be the most important drivers of the cost effectiveness of treatments for Crohn’s disease.

References


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