NHS Innovation Accelerator

Economic Impact Evaluation Case Study: Liver Disease Diagnostic Pathway

1. BACKGROUND

The aim of the liver disease diagnostic pathway is to identify people at risk of chronic liver disease at the critical stage at which it can either progress or reverse. Liver disease is the third largest cause of early death in the United Kingdom. This is due to both alcoholic liver disease (ALD) and non-alcoholic fatty liver disease (NAFLD), which are increasing in the population due to the prevalence of alcohol misuse, obesity and Type 2 diabetes.¹

The liver disease diagnostic pathway combines the proactive identification in the GP database of patients at risk of chronic liver disease, with a seamless integrated pathway between primary and secondary care. The pathway utilises transient elastography to detect significant but asymptomatic chronic liver disease. This non-invasive diagnostic test (Fibroscan®) can be carried out at a general practice. It calculates the stiffness of the liver by measuring the propagation of an elastic shear wave whereby different thresholds correlate with the stages of liver fibrosis.² Based on the results, patients in the pathway are classed as either no/mild liver disease, significant liver disease or cirrhosis, and are treated accordingly.

The proactive nature of the liver disease diagnostic pathway (also known as the ‘innovative diagnostic pathway’ - IDP), leads to patients being identified much earlier compared to current diagnostic processes.³ This leads to earlier treatment of liver disease, either halting the condition, or dramatically improving patient outcomes and reducing subsequent demand on healthcare.

¹ Tanajewski L et al. Economic evaluation of an innovative diagnostic pathway: Non-alcoholic Fatty Liver Disease (NAFLD) and Alcoholic Liver Disease (ALD). East Midlands AHSN. Not dated.
The pathway has been implemented as a pilot in a number of GP practices in the East Midlands AHSN area and has been found to identify more people with liver disease than the standard care pathway (SC). An economic evaluation has been undertaken by the AHSN to determine the cost-effectiveness of the innovative diagnostic pathway. This study, conducted by Professor Rachel Elliott and her team, has concluded that the pathway is cost effective from an NHS and social care perspective. This case study gives a summary of the methodology and complex analysis undertaken and gives an overview of the conclusions.

2. OVERVIEW OF ECONOMIC ANALYSIS METHODOLOGY

The team undertaking the economic analysis developed a comprehensive economic model to simulate the effect of the pathway on overall patient outcomes and NHS costs.

The parameters in the analysis are described in Table 2.1.

### Table 2.1: Parameters in the economic analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>Patients at risk of chronic liver disease. Starting age of 68 years for NAFLD and 43 years for ALD.</td>
</tr>
<tr>
<td>Intervention</td>
<td>Innovative diagnostic pathway (also known as liver disease diagnostic pathway)</td>
</tr>
<tr>
<td>Comparator</td>
<td>Standard care</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Utility values and costs associated with the following health states: No/mild liver disease (T1 - fibrosis Stage 0 or 1); Significant liver disease (T2 - fibrosis Stage 2 or 3); Compensated cirrhosis (T3 - fibrosis Stage 4, Baveno Stage I or II); Decompensated cirrhosis (T4 - Baveno stage III or IV); Hepatocellular carcinoma (HCC); Liver transplant (a patient in transplant and post-transplant years); Death.</td>
</tr>
</tbody>
</table>

Literature evidence and expert opinion were used to estimate, for the Innovative Diagnostic Pathway (IDP) and standard care (SC), the probabilities of each health state occurring, the utility values and the resource use associated with each of the health states. These were combined, to generate the cost per quality-adjusted life-year (QALY) for both NAFLD and ALD. Comprehensive sensitivity analysis was performed to allow for uncertainty in the values used.

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6 Rachel Elliott, Professor of Health Economics, University of Manchester.
2.1 Resource Use

The resources used in treatment and care for the different stages of liver disease (health states) were broken down for the IDP compared with SC. Typically the pathways comprise the following types of resources:

- **Primary care:** GP clinic visits;
- **Secondary care:** planned out-patient appointments (first and follow-up); nurse telephone consultations; emergency admissions for liver disease related conditions (e.g. cirrhosis, ascites, oesophageal varices); planned admissions for liver disease related conditions; liver transplant;
- **Diagnostic tests:** oesophagastroduodenoscopy (OGD), Fibroscan, hepatitis B/C scan, liver biopsy, liver function test, ultrasound;
- **Other services:** alcohol referral services; dietician appointment; hospital transport.

Resource use was assumed to be the same in both pathways once patients had been diagnosed. The costs associated with the different health states were calculated for the IDP and for SC using validated sources, such as NHS Reference Costs, Personal Social Services Research Unit and NHS pay scales. Costs were inflated to the 2013/14 financial year and where multiple possible costs were available, ranges were used in the analysis.

An NHS and social care perspective was taken, with indirect costs of illness, such as informal care, lost productivity, time expended by the patients or their carers and wider societal costs, being excluded from the analysis.

2.2 Potential Impacts of the IDP

Differences in resource utilisation from the implementation of IDP compared with SC may occur due to:

- The IDP intervention;
- Reduction in referrals to secondary care and subsequent diagnostic tests for those patients stratified to be at low risk for chronic liver disease in the IDP;
- Positively identifying those patients who are at risk of liver disease and increasing awareness of how lifestyle modifications can reduce the probability of developing significant liver disease and thus reducing the progression of liver disease to more costly health states;
- Increased identification of people who need intervention - patients being diagnosed with significant liver disease or compensated cirrhosis at an earlier stage when interventions (lifestyle modifications +/- treatment) may reduce the progression of liver disease to more costly health states.
ECONOMIC ANALYSIS

A cost-utility analysis was undertaken, using Markov modelling techniques. The treatment pathway models for the IDP and SC were populated with UK relevant probabilities of the different health states occurring, utilities associated with the health states and resource use data for these health states, combined with estimates of IDP effectiveness compared with SC. The cycle length for the model was one year, with a lifetime time horizon, with costs and utilities being discounted at 3.5%. The base case year was costed as 2014.

The modelling generated the following data for the IDP and SC pathways:

- Total cost of pathway for all possible health states for liver disease;
- Total quality of life associated with these health states, measured by QALYs.

The incremental cost-effectiveness ratio (ICER) was calculated, giving the cost per QALY for the IDP for both NAFLD and ALD. Using assumptions stated in the analysis, the base case analyses for the two conditions are summarised in the tables below.

### Table 3.1: Incremental cost effectiveness of the IDP for NAFLD

<table>
<thead>
<tr>
<th></th>
<th>Cost (£)</th>
<th>Incremental cost (£), IDP vs. SC</th>
<th>QALY</th>
<th>Incremental QALY, IDP vs. SC</th>
<th>ICER (£/QALY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDP</td>
<td>9,017</td>
<td>512</td>
<td>8.49</td>
<td>0.24</td>
<td>2,138</td>
</tr>
<tr>
<td>SC</td>
<td>8,505</td>
<td></td>
<td>8.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One-way sensitivity analyses demonstrated that the factors having the greatest impact on the ICER were varying the rate of fibrosis progression (£928 to £7,032 per QALY gained) and the effectiveness of treatment in reducing this (-£1,895 to £5,969 per QALY gained).

### Table 3.2: Incremental cost effectiveness of the IDP for ALD

<table>
<thead>
<tr>
<th></th>
<th>Cost (£)</th>
<th>Incremental cost (£), IDP vs. SC</th>
<th>QALY</th>
<th>Incremental QALY, IDP vs. SC</th>
<th>ICER (£/QALY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDP</td>
<td>46,927</td>
<td>2,973</td>
<td>10.67</td>
<td>0.45</td>
<td>6,537</td>
</tr>
<tr>
<td>SC</td>
<td>43,954</td>
<td></td>
<td>10.21</td>
<td></td>
<td></td>
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</tbody>
</table>

One-way sensitivity analyses showed the greatest impact on the ICER was the reduction of fibrosis progression upon detection, and alcohol intervention for ALD, with the ICER ranging from £4,198 to £10,082 per QALY gained.

For a CCG with a combination of people with NAFLD (31.8%) and ALD (68.2%), the overall cost-effectiveness of the IDP was calculated to be £5,669 per extra QALY.
4. IMPACT ON EMPLOYMENT

Although the IDP has no expected impact on the workforce required to deliver care, liver disease has societal impacts and an impact on productivity, due to being the third largest cause of premature death in the UK. The ONS has estimated that 62,000 years of working life are lost to liver disease each year.\(^7\)\(^8\)

5. CONCLUSION

This economic analysis found that, for a Clinical Commissioning Group (CCG) with an average combination of NAFLD and ALD in its population, the IDP is likely to be cost-effective according to the NHS England willingness-to-pay threshold of £20,000 per QALY, as summarised in Table 5.1. While the intervention costs more than standard of care, it generates greater levels of benefit. The scale of benefits is increasing as the pathway is introduced into more CCGs.

Table 5.1: Cost per QALY of the IDP for NAFLD and ALD

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cost per QALY/£</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAFLD</td>
<td>£2,138</td>
</tr>
<tr>
<td>ALD</td>
<td>£6,537</td>
</tr>
</tbody>
</table>

Furthermore, this is likely to be a conservative estimate due to there being consequences that were not included in the economic model e.g. reduced CVD, reduced mental health problems, increased productivity and reduced crime.

The quality of evidence used in the analysis was good, with the effectiveness of pathway, probabilities of disease progression and estimates of resource use being drawn from a literature review and an expert hepatology panel.

Having been introduced as a successful pilot, the liver disease diagnostic pathway is now a formally commissioned pathway for four CCGs in Nottingham. The economic evaluation was used to inform the business case for this development, which is being monitored and evaluated by the East Midlands AHSN. In the six months since its introduction, approximately 500 people have been through the pathway and it is perceived to be facilitating appropriate referrals from primary to secondary care. In order to contribute to the spread of the innovation across the country, a toolkit is being developed to assist local areas to adapt it appropriately.\(^9\)

York Health Economics Consortium
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\(^9\) NIA Fellow, May 2017