

# Which test is best for *Helicobacter pylori*?

## A cost-effectiveness model using decision analysis

Glyn Elwyn, Mark Taubert, Shan Davies, Ginevra Brown, Miles Allison and Ceri Phillips

### ABSTRACT

GPs face a potential dilemma in deciding which test to use for detection of *Helicobacter pylori*. For patients with dyspepsia, the National Institute for Health and Clinical Excellence (NICE) advises primary care practitioners to adopt a 'test and treat' policy before considering a referral for gastroscopy. There are many ways of testing: serology, urea breath test, and faecal antigen test. NICE does not advocate any preferred single test for detecting *H. pylori*. In the current study a multi-stakeholder 2-day workshop was established to agree and populate a cost-effectiveness decision analysis model. The aim was to analyse the three types of tests available for *H. pylori* and to determine which is the most practical and cost effective. Agreement on the costs and diagnostic values to be entered into the decision-analytic model was achieved. Results indicate that the faecal antigen test was the most effective in terms of true outcomes and cost. One thousand virtual patients were allocated to each of the three tests. Serology had 903, urea breath test had 961, and the faecal antigen test had 968 true positive outcomes. Data indicate that the faecal antigen test is the preferable strategy for diagnosis of *H. pylori* in primary care. This has implications for implementing new testing processes and for commissioning new diagnostic pathways for use in primary care.

### Keywords

dyspepsia; faecal antigen test; *Helicobacter Pylori*; urea breath test.

### INTRODUCTION

Although guidelines for the management of dyspepsia advocate a 'test and treat' policy for *Helicobacter pylori*,<sup>1</sup> there remains debate about which diagnostic test should be requested by primary care practitioners.<sup>2</sup> The level of testing is increasing; however, referrals for gastroscopies are often requested before possible *H. pylori* infection has been established and eradicated. Serology has been the most widely used test to date, but sensitivity and specificity are comparatively low. The urea breath test (available recently as a near-patient kit) is a non-invasive test, but is not easy to perform. The recent arrival of faecal antigen tests, which are relatively straightforward to collect, provide evidence to confirm successful eradication of *H. pylori*, as does the breath test. However, the widespread use of these tests will require a change in clinical and laboratory practice. Clinicians in primary care need to know which test to use; therefore, a cost-effectiveness analysis of these testing strategies was conducted.

### METHOD

A 2-day workshop involved 24 participants: five GPs, five gastroenterologists, four health service managers, two microbiologists, two pharmacists, one primary care organisation finance director, two health service researchers, and three health economists. Participants received articles about the diagnostic accuracy of the relevant diagnostic tests.<sup>3</sup> An appraisal of the three tests (urea, serology, and monoclonal faecal) and their resource requirements was conducted to provide data for a cost-effectiveness model.

The model contained the following cost variables: test acquisition, staff time, eradication treatment, the estimated service burden of false negatives and false positives, and the estimated cost of managing undiagnosed patients, using a 3-month time frame (Table 1). The model was developed using Treeage Pro 2005 Decision Analysis package (Treeage Software Inc, Williamstown, MA) and populated with 1000 hypothetical patients presenting with dyspepsia, assuming a 25% population prevalence of *H.*

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## How this fits in

The suggested management of dyspepsia in general practice involves a 'test and treat' strategy in which *Helicobacter pylori* investigation is indicated. Serology has been the most widely used test, but the sensitivity and specificity of this test is comparatively low. The urea breath test is the most accurate non-invasive test, but is not as easy to perform, although near-patient kits have been made available recently. The arrival of faecal tests, which are relatively straightforward to collect but which require a change in laboratory practice, prompted comparison of the cost-effectiveness of these three testing strategies. This study shows that, based on available data, the faecal antigen test for *H. pylori* is more accurate and cost-effective. Adopting this test requires a change in the diagnostic process and in the configuration of laboratory services.

**Table 1. Health status of patients at time of interviews.<sup>a</sup>**

| Description   | Baseline value | Minimum value | Maximum value |
|---|----------------|---------------|---------------|
| Prevalence constant   | 0.25           | 0.2           | 0.4           |
| Cost of urea breath test  | £20.00         | £15.00        | £21.05        |
| Cost of serology  | £8.50          | £7.50         | £9.38         |
| Cost of faecal antigen test   | £14.00         | £12.00        | £19.00        |
| Cost of eradication treatment   | £30.00         | £9.00         | £38.00        |
| Cost of missed diagnosis — based on cost of gastroscopy (£196), cost of 2 months of high dose PPI (£44), and one extra GP visit (£20) | £260           | £0            | £500          |
| Sensitivity of urea breath test   | 0.97           | 0.80          | 0.99          |
| Sensitivity of serology   | 0.91           | 0.80          | 0.95          |
| Sensitivity of faecal antigen test  | 0.96           | 0.80          | 0.97          |
| Specificity of urea breath test   | 0.96           | 0.80          | 0.99          |
| Specificity of serology   | 0.90           | 0.70          | 0.90          |
| Specificity of faecal antigen test  | 0.97           | 0.80          | 0.97          |

PPI = protein pump inhibitor.

<sup>a</sup>For the least effective test, the incremental cost-effectiveness ratio (ICER) is equivalent to the mean cost per true positive. For the remaining tests, the ICER is calculated as the difference in cost divided by the difference in effectiveness.

**Table 2. Incremental cost-effectiveness ratios (ICER).**

| Test                | Cost / 1000 tests (£) | Effectiveness (number of true outcomes) | ICER <sup>a</sup> (£) |
|---------------------|-----------------------|---|-----------------------|
| Serology test       | 16 600                | 903                                     | 18.38                 |
| Breath test         | 23 175                | 961                                     | 113.36                |
| Faecal antigen test | 17 275                | 968                                     | Best                  |

<sup>a</sup>See footnote Table 1.

*pylori*.<sup>2</sup> Tornado sensitivity analysis is the simultaneous comparison of analyses on the cost-effectiveness model, where values are altered from minimum through to maximum values. Incremental

cost-effectiveness ratios (ICERs) were calculated and a tornado sensitivity analysis was performed to rank the level of influence of each variable on the cost-effectiveness results.

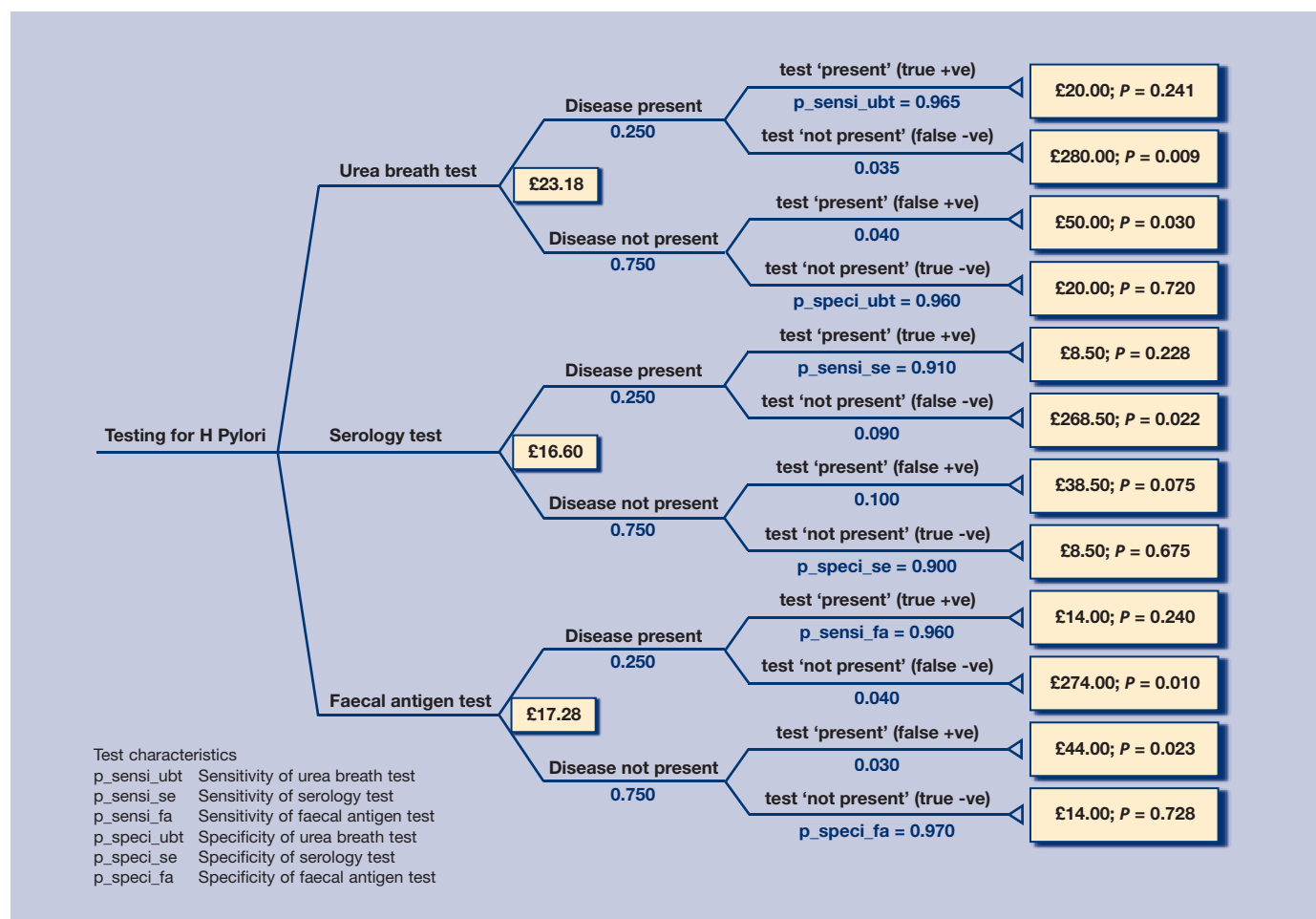
## RESULTS

The decision analysis for cost of the three tests is summarised in Figure 1. The least effective test was serology, giving 903 true outcomes per 1000 tested, for a cost of £16 600 for 1000 tests, and a mean cost of £18.38 per true positive test (Table 2). This test therefore had 97 false outcomes (false negatives or false positives). The breath test had 961 true positive outcomes for a cost of £23 175. The most effective was the faecal antigen test with 968 true outcomes for a cost of £17 275, a mean cost of £17.84 per true positive test. The ICER for the breath test when compared with serology was £113.36: this is the difference in cost (£23 175 less £16 600) divided by the gain of 58 true positive outcomes. The faecal antigen test is more effective and less costly than the breath test, and therefore performs better. The ICER for the faecal antigen test compared with the serology test is £10 (£17 275 less £16 600 divided by 65 additional true outcomes).

Tornado analysis indicated that the variable with the greatest influence is the population prevalence of *H. pylori*, accounting for 50% of the possible variation. The variables least likely to have an effect are cost, specificity, and sensitivity of the breath test. One-way sensitivity analyses showed that in two separate scenarios where prevalence rates varied 20% and then 40%, the faecal test is the most cost-effective test. These analyses also showed that if the prevalence of *H. pylori* is greater than 31% in the population to be tested, then the faecal test performs better than both other tests. One-way sensitivity analysis was performed on the cost of missed diagnosis, which applies to scenarios where the test result returned '*H. pylori* not present'. Varying from the £260 baseline to between £0 and £500, this analysis showed that throughout this range, and crucially at zero cost for a missed diagnosis, the faecal test continues to perform better than the breath test. If the cost of missed diagnosis is greater than £314, the faecal test performs better than both breath testing and serology.

## DISCUSSION

On the basis of this cost-effectiveness analysis, the faecal antigen test should replace the other two tests. This study did not take into account the impact of patient and practitioner preferences for faecal testing compared with the other two tests. However,



faecal tests are accepted for other areas of practice and, if implemented, this strategy would lead to increasing economies of scale and help practitioners to achieve improved compliance with the 'test and treat' policy. Serology remains the most commonly used non-invasive *H. pylori* test; however, it is less accurate than urea breath test and faecal monoclonal antibody testing. Serology is unable to distinguish active from previous infection, while positive results on faecal antigen tests after completion of eradication therapy identify patients who are still *H. pylori* positive.<sup>4</sup> The urea breath test, while being as accurate as the faecal test, is more cumbersome to perform. The resulting lack of enthusiasm by patients and GPs for breath testing may lead to missed opportunities for eradication therapy and excessive use of proton pump inhibitors.

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#### Ethics committee

Not applicable

#### Competing interests

The authors have stated that there are none

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Figure 1. Decision tree for costs of three *Helicobacter pylori* tests.