Timing and scheduling of endoscopic procedures
Sonnenberg A

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The health interventions examined in the study were four endoscopic procedures for patients with jaundice or gastrointestinal haemorrhage: colonoscopy, Esophagogastroduodenoscopy (EGD), computer axial tomography (CT), and endoscopic retrograde cholangiopancreatography (ERCP).

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients requiring endoscopic procedures due to jaundice or gastrointestinal haemorrhage.

Setting
The setting was hospital. The economic study was carried out at the Department of Veterans Affairs Medical Centre in Albuquerque, New Mexico, USA.

Dates to which data relate
No dates on effectiveness and resource use were reported. The price year was 1998.

Source of effectiveness data
Data on effectiveness were based on the author’s opinions.

Modelling
A model based on the stochastic sequence of different medical states was used to determine the transition probabilities of moving among states in strategy 1 (where the scheduling of endoscopic procedures depend on the symptoms and patients enter the model randomly) and in strategy 2 (where the order of diagnostic tests is scheduled on the basis of the cost of the procedures). It is clear that in the models that analyse strategies 1 and 2, the diagnosis can be reached with a minimum (one) or a maximum (four) number of procedures. Data used in the model (transition probabilities) were based on the author’s assumptions and were then processed using a Monte Carlo simulation, as described below.

Methods used to derive estimates of effectiveness
The author made some assumptions, which were used in the decision model. These assumptions were then varied in the sensitivity analyses.
Estimates of effectiveness and key assumptions
The author assumed that the diagnostic yield of each test was 0.25. It was also assumed that a definitive diagnosis could be made with one of the tests. In strategy 1, the probability of undergoing one of the four diagnostic tests was 0.25, in other words, all tests were equally likely to be selected as first test; after each negative test the number of remaining options decreases and the transition probabilities are re-adjusted accordingly. In strategy 2, the evaluation starts with CT (the cheapest procedure) and is followed by EGD, colonoscopy, and ERCP. In strategy 3, all tests are performed, as stated earlier.

Measure of benefits used in the economic analysis
The period of time required to reach a diagnosis was obtained from the stochastic model. However, it cannot be considered as a summary benefit measure, as it was not used in combination with costs. As a result, a cost-consequences analysis was conducted.

Direct costs
Discounting was not relevant due to the short time frame of the analysis. Unit costs were reported, but quantities of resources were not. The cost items included in the economic evaluation were CT; EGD and biopsy; colonoscopy and biopsy; ERCP and radiology; abdominal ultrasound; radiological examination of gastrointestinal tract; nuclear scan for gastrointestinal blood loss; magnetic resonance cholangiopancreatography (MRCP); and hospital day. The costs of treating potential complications after endoscopy were not included in the analysis. Invasive forms of ERCP, such as sphincterotomy, stone extraction, or stent placement, were not considered. For outpatients, both physician and facility costs were considered, while for inpatients facility charges were not incurred and the cost of hospital stay was considered and charged depending on the length of waiting days. The cost of a hospital day was based on Diagnosis Related Group (DRG) reimbursement rates. The remaining costs were estimated from average payments allowed for each procedure by the US Health Care Finance Administration. The cost/resource boundary adopted was not explicitly stated, but appears to have been that of the hospital, as reimbursed by the financing authority. The price year was 1998.

Statistical analysis of costs
Costs were treated deterministically in the base case.

Indirect Costs
Indirect costs were not included in the analysis.

Currency
US dollars ($).

Sensitivity analysis
Monte Carlo simulations were performed to run the stochastic model over a hypothetical group of 5,000 patients with varying sequences of tests. Three sensitivity analyses were conducted to assess the impact of some data on the estimated costs and health outcomes. In the first sensitivity analysis, the costs included in the model were calculated for both inpatients and outpatients; in the second sensitivity analysis, the waiting times of each endoscopic procedure were reduced by one day or increased by 1 to 4 days; and in the third sensitivity analysis, the diagnostic probability of each procedure was varied between 0 and 1. Finally, beside the scenario presented as base case, two other scenarios were presented in which patients suffered from slightly different forms of jaundice or gastrointestinal haemorrhage: all three scenarios were intended to represent actual cases requiring endoscopic procedures.

Estimated benefits used in the economic analysis
In the base case, the period of time required to reach a diagnosis was 5 +/-2.3 days in strategy 1, 4.2 +/-2.5 days in...
strategy 2, and 3 days in strategy 3.

**Cost results**
The cost results were as follows:

Inpatient costs were $5,500 +/- $2,500 in strategy 1, $4,600 +/- $2,900 in strategy 2, and $4,000 in strategy 3.

Outpatient costs were $1,600 +/- $800 in strategy 1, $1,300 +/- $900 in strategy 2, and $2,600 in strategy 3.

In the scenario of a patient with jaundice, inpatient and outpatient costs were $4,000 +/- $2,000 and $1,100 +/- $600 in strategy 1, $3,100 +/- $2,000 and $800 +/- $600 in strategy 2, and $3,500 and $1,800 in strategy 3.

In the scenario of a patient with gastrointestinal bleeding, inpatient and outpatient costs were $4,000 +/- $1,900 and $1,100 +/- $500 in strategy 1, $4,000 +/- $2,100 and $1,100 +/- $600 in strategy 2, and $2,600 and $1,800 in strategy 3.

The sensitivity analysis showed that the outcome in inpatients was sensitive to changes in costs associated with waiting times: short waiting times favoured the first two strategies, while longer waiting times favoured strategy 3.

The estimated costs were also sensitive to variations in the diagnostic yield of the endoscopic procedures: only if the prior probability assigned to the most likely diagnosis exceeded a threshold between 40% and 70% would strategy 1 (the choice of the most promising procedure) be cost-saving in comparison with the remaining strategies.

**Synthesis of costs and benefits**
Costs and benefits were not combined in a cost-effectiveness ratio, as a cost-consequences analysis appears to have been conducted.

**Authors' conclusions**
The author concluded that strategy 3 (performing all tests simultaneously) represented the least costly option in hospitalised patients, followed by strategy 2 and strategy 1. However, in outpatients, strategy 2 (from the least to the most expensive procedure) was the cheapest, followed by strategy 1 and strategy 3.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparators was not clear. The four endoscopic procedures represented possible diagnostic interventions for patients with jaundice or gastrointestinal haemorrhage. However, the frequency of their use in practice was not clear. Nor was it clear whether other strategies were possible. You, as a user of this database, should decide whether they represent commonly used procedures in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness estimates were based on a set of assumptions made by the author. The purpose of the assumptions was to create hypothetical scenarios, which were then varied to simulate real-world situations that physicians may face with patients with jaundice or gastrointestinal haemorrhage. No support from the literature was reported for the data used in the stochastic model. To take into account the uncertainty around the data, the author performed several sensitivity analyses and analysed different scenarios, but, again, these analyses were based on the author's own assumptions. In fact the author acknowledged that the model was simplistic, but justified this partly on the grounds that a more realistic model would have been too complex. However, it would seem reasonable to have included empirical data on test accuracy.

**Validity of estimate of measure of benefit**
No summary benefit measure was used in the economic analysis. The analysis was therefore categorised as a cost-consequences study (see validity of effectiveness comments above). The measure used was time to diagnosis. It would
seem reasonable, if empirical data on test accuracy had been used, to consider the possibility of not making a diagnosis or it being delayed beyond that hospital episode. This would seem to have implications for health outcome.

**Validity of estimate of costs**

The perspective adopted in the study was not explicitly stated, although it appears to have been that of the hospital. Some costs, such as those related to management of complications, were not included in the analysis and the impact of such omission was not discussed. Cost estimates were specific to the US setting. The source of cost data was reported. Unit costs and quantities of resources used were not reported separately, thus reducing transparency and generalisability. The price year was appropriately given.

**Other issues**

The author did not compare the study findings with those from other studies. The issue of the generalisability of the study results to other settings was not addressed, although some sensitivity analyses were performed. The analysis referred to patients requiring endoscopic procedures due to jaundice or gastrointestinal haemorrhage, and this was reflected in the conclusions of the study.

**Implications of the study**

The author noted that, under the economic pressure posed by reimbursement rules in the USA, the physician may decide to undertake strategy 3 (all tests simultaneously) and then cancel scheduled future tests once the diagnosis is reached, as there are no charges of foregone or cancelled appointments. However, it was also noted that "scheduling of many provisional procedures would eventually overload the diagnostic units". The main implication of the analysis was that rules for scheduling of endoscopic procedures are required, but the risk of delaying a definitive diagnosis has to be taken into account. Thus in many cases the best procedure may be that guided solely by medical considerations, based on patient's symptoms. These conclusions should be viewed in the light of the caveats discussed above, particularly with regard to the use of author's assumptions to populate the model.

**Source of funding**

Supported by a grant from the Centers for Disease Control and Prevention.

**Bibliographic details**

Sonnenberg A. Timing and scheduling of endoscopic procedures. Gastrointestinal Endoscopy 2000; 52(2): 204-211

**PubMedID**

10922092

**DOI**

10.1067/mge.2000.107717

**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Aged; Appointments and Schedules; Endoscopy, Gastrointestinal /economics /methods; Female; Health Care Costs; Humans; Male; Monte Carlo Method; New Mexico; Patient Care Planning /economics /standards; Sensitivity and Specificity

**AccessionNumber**

22000001334

**Date bibliographic record published**

NHS Economic Evaluation Database (NHS EED)
31/03/2003

Date abstract record published
31/03/2003