A cost-minimization analysis of alternative strategies in diagnosing pancreatic cancer
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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
Four diagnostic strategies for patients with suspected pancreatic cancer were examined. The strategies were:

- computed tomography or ultrasound-guided fine-needle aspiration (CT/US-FNA),
- endoscopic retrograde cholangiopancreatography with brushings (ERCP-B),
- endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA), and
- laparoscopic surgical biopsy (surgery).

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of patients with suspected pancreatic cancer. All the patients had pancreatic mass lesions detected on precedent imaging, suggesting pancreatic cancer, but were without confirmation of the diagnosis at presentation.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1986 and 2003. No dates for the resource use data were explicitly reported. The price year was 2003.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of completed studies and authors' assumptions.

Modelling
A decision tree model was constructed to evaluate the expected costs and outcomes associated with the four biopsy modalities for suspected pancreatic cancer in a hypothetical cohort of patients. Each patient underwent one of the four routine diagnostic procedures that could be either successful or unsuccessful. After a successful procedure, the patient was categorised into positive or negative, and had a predetermined probability of experiencing some procedural-related complications. After a failure, an alternative diagnostic modality was undertaken, with the patient being categorised as...
before. However, in the case of an unsuccessful second modality, no further diagnostic procedure was performed. The same sequences were repeated for the four modalities. The patients were considered as equally suitable candidates for all diagnostic options. However, an alternative decision tree was created for patients with obstructive jaundice, where patients underwent ERCP with biliary stent placement. The costs and the outcomes occurring after patient diagnosis or hospital discharge were not considered. A short time horizon was used. The alternative models and all patient pathways were illustrated in the article.

**Outcomes assessed in the review**

The outcomes estimated were:

- the failure rate,
- the sensitivity and specificity,
- the positive and negative predictive values (PPV and NPV), and
- the complication rates.

**Study designs and other criteria for inclusion in the review**

It was unclear whether a systematic review of the literature had been undertaken. The design of the primary studies was not reported.

**Sources searched to identify primary studies**

MEDLINE was searched for relevant studies. The keywords used were "pancreatic mass", "pancreatic cancer", "ultrasound-guided (US) fine-needle aspiration (FNA)", "computerized tomography-guided (CT) fine-needle aspiration (FNA)", "endoscopic retrograde cholangiopancreatography (ERCP)", "endoscopic ultrasound-guided (EUS) fine-needle aspiration", "laparoscopic biopsy" and "surgical biopsy".

**Criteria used to ensure the validity of primary studies**

The authors stated that there was a lot of variability in the quality of the primary studies. The studies were reviewed for clinical relevance and validity. An extended follow-up was considered an important element for judging the quality of the primary studies. Other criteria used to ensure the validity of the primary sources were not explicitly reported.

**Methods used to judge relevance and validity, and for extracting data**

Not stated.

**Number of primary studies included**

Thirty-six primary studies were used in the review.

**Methods of combining primary studies**

The studies were weighted by sample size to determine the average-weighted testing characteristics in a pooled analysis.

**Investigation of differences between primary studies**

Not stated.

**Results of the review**
The failure rate was 10% with CT/US-FNA, 7% with ERCP-B, 5% with EUS-FNA, and 1% with surgical biopsy.

The sensitivity was 81% with CT/US-FNA, 61% with ERCP-B, 89% with EUS-FNA, and 92% with surgical biopsy. The specificity values were 96% (CT/US-FNA), 99% (ERCP-B), 94% (EUS-FNA), and 100% (surgical biopsy), respectively.

The PPV was 96% with CT/US-FNA, 99% with ERCP-B, 99% with EUS-FNA, and 100% with surgical biopsy. The NPVs were 38% (CT/US-FNA), 60% (ERCP-B), 66% (EUS-FNA), and 77% (surgical biopsy), respectively.

The complications rate was 4% with CT/US-FNA, 2% with ERCP-B, 2% with EUS-FNA, and 15% with surgical biopsy.

Methods used to derive estimates of effectiveness
The authors made assumptions to derive some effectiveness estimates and to define the clinical pathways of the decision model.

Estimates of effectiveness and key assumptions
It was assumed that the prevalence of pancreatic cancer was 97%.

Measure of benefits used in the economic analysis
The summary benefit measure used was the success rate. This was obtained from the decision model. The successful diagnosis of pancreatic cancer was assigned a value of 1, while an unsuccessful diagnosis was attributed a value of 0.

Direct costs
Discounting was not relevant since the costs were incurred during the short term. The unit costs were presented, but limited resource use data were provided. Some costs were reported as macro-categories. The health services included in the economic evaluation were the diagnostic option under evaluation, other diagnostic procedures, pathology processing and interpretation, and hospital stay due to complications. The long-term costs occurring after patient diagnosis or hospital discharge were not considered. The cost/resource boundary of the third-party payer was adopted. The costs were derived from Medicare charges, using Current Procedural Terminology, diagnosis-related group, and ICD-9 codes. Other costs were derived from the University of Alabama at Birmingham Hospital. The resource use data were mainly derived from authors' assumptions. The price year was 2003.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not considered in the economic evaluation.

Currency
US dollars ($).

Sensitivity analysis
Univariate and two-way sensitivity analyses were carried out to examine the robustness of the estimated cost-effectiveness ratios to variations in the model inputs. The variables investigated were the total costs, complication costs, failure rate, sensitivity and specificity of the diagnostic procedures, and complication rate. A threshold analysis was also performed. Values below and above which the final conclusions would have changed were presented.
Estimated benefits used in the economic analysis
The estimated rate of a successful diagnosis of pancreatic cancer was 96% with EUS-FNA, 92.3% with ERCP-B, 93.9% with CT/US-FNA, and 96.1% with surgical biopsy.

Cost results
The total costs per patient were $1,405 for EUS-FNA, $1,432 for ERCP-B, $3,682 for CT/US-FNA, and $17,711 for surgical biopsy.

Synthesis of costs and benefits
Average and incremental cost-effectiveness ratios were calculated to combine the costs and benefits of the alternative diagnostic procedures. The average cost per successfully diagnosed patient was $1,464 for EUS-FNA, $1,551 for ERCP-B, $3,921 for CT/US-FNA, and $18,430 for surgical biopsy. After excluding the dominated options (ERCP-B and CT-US-FNA), the incremental cost per successfully diagnosed patient with surgery over EUS-FNA, which was the reference strategy, was $16,306,000.

The analysis showed that EUS-FNA was the secondary modality of choice after the failure of the other three diagnostic procedures. Surgical biopsy was the preferred second strategy after EUS-FNA failed. EUS-FNA remained the second preferred strategy, also in the setting of patients with obstructive jaundice.

The results were robust to variations in the prevalence of cancer. The sensitivity and threshold analyses also revealed that unrealistic variations in costs and probability values were required to change the results of the base-case.

Authors’ conclusions
Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) was the most cost-effective strategy for the diagnostic management of patients with suspected pancreatic cancer, and as a follow-up diagnostic option after endoscopic retrograde cholangiopancreatography (ERCP) for patients with obstructive jaundice.

CRD COMMENTARY - Selection of comparators
The selection of the comparators aimed to include the most common diagnostic procedures for the detection of pancreatic cancer. However, the authors acknowledged that the four strategies might not be available simultaneously in all centres, especially EUS-FNA.

Validity of estimate of measure of effectiveness
The effectiveness evidence came from a review of the literature, which does not appear to have been systematic since the relevant studies were identified from a single database. The authors acknowledged that the evidence came from studies of different validity and specific criteria to ensure the quality of the evidence were not used. However, the authors stated that the studies were reviewed for clinical relevance and validity. Pooled weighted estimates were calculated to account for differences in sample size. The issue of uncertainty was addressed in the sensitivity analysis.

Validity of estimate of measure of benefit
The summary benefit measure was specific to the disease considered in the study. As such, it appears hardly comparable with the benefits of other health care interventions. The authors attributed a value of 1 to success and 0 to failure, owing to the cost-minimisation approach used in the model.

Validity of estimate of costs
The perspective adopted in the study was explicitly reported. It appears that all the relevant categories of costs have been included in the analysis. The source of the data was provided, as was the price year, which aids reflation exercises.
in other settings. The costs were treated deterministically, but some cost estimates were varied in the extensive sensitivity analysis. A breakdown of the cost items was not reported for all categories, which reduces the possibility of replicating the study. Some costs were derived from authors’ assumptions.

**Other issues**
The authors reported the results of other economic evaluations that supported the use of EUS-FNA for the detection of pancreatic cancer. The issue of the generalisability of the study results to other setting was in part addressed in the sensitivity analyses, where most model inputs were varied. The study referred to patients with suspected pancreatic cancer and this was reflected in the authors’ conclusions.

**Implications of the study**
The authors noted that in settings where EUS-FNA was not available, ERCP-B was the preferred strategy, especially for patients with obstructive jaundice.

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None stated.

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**Other publications of related interest**


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