Cost-analysis of four diagnostic strategies for Pneumocystis carinii pneumonia in HIV-infected subjects

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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
Diagnostic strategies for Pneumocystis carinii pneumonia in HIV-infected patients.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
HIV-infected patients with suspected PCP. Additional patient characteristics were not specified.

Setting
Hospital. The study was conducted in Paris, France.

Dates to which data relate
The effectiveness and resource data were obtained from January to December 1992. The price years were not stated.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
Effectiveness and costing data were obtained from the same patient sample. The study was conducted prospectively.

Study sample
The initial study sample consisted of 210 patients with suspected PCP who were referred for specialist investigation. 125 patients underwent only IS, followed, if negative by BAL. 85 patients agreed to undergo indirect tests (ES and ET) prior to the IS and BAL diagnostic tests. No power calculations were employed to determine the appropriateness of the sample size.

Study design
The study design was case series. If PCP was detected by IS and/or BAL, patients were judged to have PCP. The ET results were considered abnormal if the arterial oxygen saturation at the end of the treadmill session was decreased by more than 3% when compared to the value at the beginning. Patients testing negative on both IS and BAL were
followed up for one month after the procedure and, in the absence of clinical or radiological evidence of PCP, were considered to be PCP-free. Pathologists who examined the slides were blinded to the clinical status of the patients. No loss to follow-up was reported.

**Analysis of effectiveness**
The effectiveness criterion was whether each strategy could confirm or exclude the presence of PCP, i.e. sensitivity and specificity.

**Effectiveness results**
In the overall test population, 66 out of 210 patients were diagnosed with PCP: 47 by the IS strategy alone and 19 by BAL (when IS had been negative). This gives a population prevalence of PCP of 31%. The IS strategy had a sensitivity of 71% and a specificity of 100% in detecting PCP. Among the 125 patients who did not undergo ET there were 47 cases of PCP (prevalence of 38%), 35 of whom were diagnosed by IS (sensitivity of 74%). Of the 85 patients who underwent ET, there were 19 cases of PCP (prevalence of 22%), 12 of whom were diagnosed by IS alone (sensitivity of 63%). 34 patients in this group produced abnormal ET results, including the 19 who were finally diagnosed with PCP and an additional 15 who were not (ET sensitivity 100%, specificity 77%). The prevalence of PCP was significantly higher in those patients who did not agree to undergo the ET (38% versus 22%, p<0.05) ET was found to have a sensitivity of 100% but a specificity of 77%.

**Clinical conclusions**
The optimal diagnostic strategy is greatly influenced by the prevalence of PCP in the test population. In centres where the prevalence of PCP is likely to be high, the ET strategy is not likely to bring additional benefits. However, where the prevalence of PCP is low, the ET aids diagnosis by selecting those patients most likely to have PCP.

**Modelling**
A decision tree was used to determine the cost-effectiveness ratio of each strategy.

**Measure of benefits used in the economic analysis**
Benefits were measured in terms of the sensitivity and specificity characteristics of each strategy.

**Direct costs**
Direct costs were restricted to patient charges made by the hospital and included only the cost of the tests and the cost of the microscopic analyses. Any analyses carried out prior to the tests under consideration (blood gas, chest x-ray, etc.) were considered to be the same for all strategies, and were not included. Hospitalisation costs before and after PCP tests were not included, as these were assumed to be related to PCP severity. The price year was not stated.

**Statistical analysis of costs**
Statistical analysis of costs was not carried out.

**Indirect Costs**
Indirect costs were not included.

**Currency**
French Francs (FF).
Sensitivity analysis
Iso-cost curves were calculated by varying key parameters: prevalence of PCP, cost, sensitivity and specificity for the IS and ES strategies. Using the BAL as a reference strategy, cost reductions were obtained for other strategies.

Estimated benefits used in the economic analysis
In the overall test population, with a prevalence of 31%, the IS strategy had a sensitivity of 71% and a specificity of 100% in detecting PCP. Among the 125 patients who did not undergo ET the prevalence was 38% and the sensitivity of IS in this population was calculated to be 74%. Of the 85 patients who underwent ET the prevalence was 22% and the sensitivity of IS was 63%. ET was found to have a sensitivity of 100% but a specificity of 77%.

Cost results
The cost of BAL was estimated to be FF1,000, and the IS/BAL and ET/BAL cost ratios were 0.1 and 0.2 respectively. The overall costs of the BAL, IS, ET and ES strategies were FF210,000 FF191,940, FF140,700 and FF112,700 respectively. The ET strategy, which involves an indirect test, provides a saving of 45%.

Synthesis of costs and benefits
Comparing the BAL and IS strategies, where the sensitivity of IS is 60% and the specificity is 100%, the prevalence of PCP at which the IS strategy should be used is 16.6%. At even relatively low prevalence of PCP, IS should be used first in order to rule out those cases which don't have PCP. When the BAL and ET strategies were compared (with an ET sensitivity of 100% and specificity of 77%), ET should be used when the expected prevalence of PCP is less than 74%. Unless the prevalence of PCP is extremely high (74% or over), the exercise test strategy is more cost-effective than using BAL alone, as it identifies those patients most likely to have PCP. Using the BAL strategy as a reference, the ES strategy was always found to be cost-effective. With the IS strategy as a reference, the ES strategy is only cost-effective when the ET specificity is 77% and the PCP prevalence is greater than 76%. Whatever the prevalence of PCP, the BAL strategy was not found to be cost-effective. At high prevalence of PCP (above 76%), the IS strategy is the most cost-effective. At intermediate PCP prevalence (5-76%), the ES strategy is the most cost-effective, and at very low PCP prevalence (<5%), the ET strategy is the most cost-effective.

Authors’ conclusions
The authors concluded that the choice of the most cost-effective diagnostic strategy for PCP in HIV-infected patients depends on the cost and characteristics (sensitivity and specificity) of each procedure as well as the prevalence of PCP in the test population. It is therefore essential to optimise patients with clinical signs of PCP in conjunction with an analysis of local conditions when evaluating the most cost-effective strategy for diagnosing PCP.

CRD COMMENTARY - Selection of comparators
The choice of comparator for the study (Bronchoalveolar lavage) was appropriate as it is an invasive and unpleasant procedure which could be avoided by the use of the other tests being evaluated.

Validity of estimate of measure of benefit
The measure of benefit used in the analysis was not likely to have been valid. The study design used was poor, and the estimates of diagnostic accuracy were based on only 210 patients, of whom only 85 underwent two of the strategies under consideration.

Validity of estimate of costs
The costing conducted for the study was fairly limited, but may be valid given the assumptions that additional costs would be the same across strategies or were related to the severity of the condition rather than the choice of tests used.
Other issues
It is not clear whether the authors' conclusions are justified on the basis of this study. The methodology used was relatively poor, and it is not clear whether the method of estimating cost-effectiveness using 'iso-cost' curves is appropriate.

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