The cost-effectiveness of iodine 131 scintigraphy, ultrasonography, and fine-needle aspiration biopsy in the initial diagnosis of solitary thyroid nodules
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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
The study examined iodine-131 scintigraphy (I-131), ultrasonography (US) and fine-needle aspiration biopsy (FNAB) for the initial diagnosis of a solitary thyroid nodule.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients undergoing diagnostic tests for thyroid nodules. No further details of the study population were reported.

Setting
The setting was tertiary care. The economic analysis was conducted in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1990 and 2004. The resource use data were derived from the hospital database, but no dates were provided. The price year was not reported.

Source of effectiveness data
The clinical data included:

the sensitivity and specificity of FNAB;
the probability of a conclusive FNAB result;
the probability of a conclusive US result; and
the probability of a warm, hot or cold nodule by I-131 scintigraphy.

Model parameters also included data on the overall prevalence of malignancies, the prevalence of malignancy in warm, hot or cold nodules, and the prevalence of cystic lesions.

Modelling
A deterministic decision tree model was developed to simulate clinical decision-making. The diagnostic pathways of the
model were described in full and a graphical depiction of the model was presented.

**Sources searched to identify primary studies**
The data were derived from a number of published studies, no details of which were reported in this paper.

**Methods used to judge relevance and validity, and for extracting data**
The authors stated that the estimates were derived from a review of the literature. However, the methods of the review were not reported. No inclusion criteria for any parameters were reported, although it was reported that for FNAB, US and I-131 data, only those studies that were related to the diagnosis of thyroid disease were used. The sensitivity and specificity were estimated using weighted averages. The weights were proportional to the number of patients in the study.

**Measure of benefits used in the economic analysis**
The measure of benefit used was the correct classification of malignant or benign disease.

**Direct costs**
The direct costs were those of the hospital. The unit costs for FNAB, US, I-131 and hemithyroidectomy were derived from a sample of patients at the authors' institution; no further details were provided. It is therefore not possible to determine whether this costing was prospective or retrospective. The authors stated that “fully loaded operating” costs were derived from the hospital’s cost-accounting database, but it was not clear what costs were included under this umbrella term; although it implied the inclusion of overhead costs, this was not explicitly stated. A cost-to-charge ratio was applied to the “fully loaded costs” to obtain hospital costs for the tests and procedures. Discounting does not appear to have been carried out, although it was unclear if it would have been necessary given that the time horizon was likely to be short (i.e. time to diagnosis). In addition, the price year was not reported.

**Statistical analysis of costs**
Both the costs and quantities were treated deterministically.

**Indirect Costs**
In line with the perspective adopted, productivity costs were not included.

**Currency**
US dollars ($).

**Sensitivity analysis**
A number of one-way sensitivity analyses were conducted to assess parameter uncertainty. The key model parameters, which included the cost of FNAB, US, I-131 scintigraphy and hemithyroidectomy, and the sensitivity and specificity of FNAB, were varied over reasonable ranges, but the actual ranges were not reported.

**Estimated benefits used in the economic analysis**
FNAB was estimated to produce a correct diagnosis of a malignant or benign nodule in 85.4% of cases. Therefore, in the hypothetical cohort of 1,000 patients used to simulate the results, 854 would have received a correct diagnosis.

The I-131 strategy was estimated to produce a correct diagnosis in 86.1% of cases (861 out of 1,000), while US was estimated to produce a correct diagnosis in 87.2% of cases (872 out of 1,000).
Cost results
The estimated cost per patient was $715 for FNAB, $897 for I-131 and $737 for US.

Synthesis of costs and benefits
The incremental ratio for I-131 compared with FNAB was $24,554, while that for US compared with FNAB was $1,212.

The sensitivity analysis demonstrated that the results were fairly robust to variation across the ranges selected.

Authors' conclusions
Using fine-needle aspiration biopsy (FNAB) for the diagnosis of palpable thyroid nodules was the most cost-effective strategy compared with the other alternatives evaluated, assuming that the payer's willingness-to-pay threshold was less than $1,212.

CRD COMMENTARY - Selection of comparators
A justification for the selection of the comparators was given. All three are viable options as primary diagnostic tools. However, despite the fact that other studies showed FNAB to be cost-effective, the other two comparators remain popular choices and hence reflect current practice in the authors'-setting.

Validity of estimate of measure of effectiveness
The data were derived from published sources. It was stated that only those studies relating to the diagnosis of thyroid disease were included. However, no clear inclusion criteria for the review were defined. In addition, no search methods or justification for the estimates selected were reported. Some synthesis was conducted and for sensitivity and specificity a weighted average was used. For other model parameters, however, the method of synthesis was not clear. Overall, it was difficult to judge the validity of the effectiveness data given the lack of detail on the methods used to identify, select and synthesise the data.

Validity of estimate of measure of benefit
The measure of benefit was the cases correctly diagnosed, which was derived from the decision model. Whilst often considered a valid summary measure for diagnostic tests, this outcome is specific to the test and cannot be compared across other health care programmes, as would be the case with a utility measure.

Validity of estimate of costs
The analysis of the costs was performed from the perspective of the health care facility. A detailed breakdown was not provided, therefore it is difficult to ascertain whether all the relevant costs were included. The authors stated that "fully loaded operating" costs were estimated from the hospital accounting database and that a cost-to-charge ratio was applied in order to obtain hospital costs. However, it was not clear what was included in "fully loaded operating" costs. In addition, details of resources were not included. The price year was not stated and no discounting was conducted. However, as a time horizon was not reported, it is not possible to determine whether discounting was relevant.

Other issues
The authors did not compare their findings with those from other studies. However, they did acknowledge that prevalence may vary across settings, and evaluated the impact of possible variation in prevalence by means of sensitivity analysis. The base-case results and all sensitivity analysis results were presented in full, both in narrative form and graphically. The authors did not present or comment on any limitations to their analysis. It is worth noting that the incremental analysis for both US and I-131 was conducted with FNAB as the comparator. Ranking of strategies to exclude those that were dominated was not performed although, in this instance, the results suggested that I-131 was dominated (more expensive and less effective than US) and as a result would have been excluded from the incremental analysis had ranking taking place. The incremental cost-effectiveness ratio for US would not have been affected.
Implications of the study
The authors suggested that their findings support the notion that FNAB is the most cost-effective initial test currently available. They also called for prospective clinical studies to be carried out in order to validate their findings.

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