Cost-effective diagnosis of ingested foreign bodies
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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 three diagnostic approaches for adult patients complaining of retained pharyngoesophageal ingested foreign bodies. The approaches were plain film radiography (XR), computed tomography (CT) and direct endoscopy.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of adult patients complaining of ingested, retained, pharyngoesophageal foreign bodies.

Setting
The setting was a hospital. The economic study was carried out in the USA.

Dates to which data relate
The clinical data were derived from studies published between 1985 and 2004. Resource use appears to have been based on data published in 2006, supplemented by authors' assumptions. The price year was 2006.

Source of effectiveness data
The clinical data used in the decision model were:

- prevalence of retained foreign body in patients presenting with this complaint;
- rates and types of complications including mortality; and
- sensitivity and specificity rates for XR and CT (endoscopy was used as the 'gold' standard).

Modelling
A deterministic decision tree was constructed to determine the cost-effectiveness of the three diagnostic approaches using each diagnostic modality singly. A second decision tree was constructed that considered a sequential strategy consisting of a second radiological study (i.e. CT) after a negative study. This latter option was included in an attempt to obviate the high chance of false negatives with XR. The structures of both decision trees were reported and described. Typical pathways for diagnostic procedures (false positive, true positive, false negative, true negative, complications, etc.) were considered. A short-term time horizon was used.
Sources searched to identify primary studies
Many characteristics of the primary studies were reported. For example, sample size, percentage of symptomatic patients with ingested foreign bodies and diagnostic accuracy (sensitivity, specificity, true negatives, true positives, false negatives and false positives). It was also reported whether the studies were prospective or retrospective, although their designs were not explicitly reported.

Methods used to judge relevance and validity, and for extracting data
PubMed was searched for relevant studies. The search criteria and keywords were reported. Sixteen studies satisfied the established criteria and were used as sources of clinical data. Weighted averages were calculated in order to combine the clinical estimates from different sources. The authors acknowledged that many papers also included children and, when it was not possible to consider adults alone, data for adults and children were combined.

Measure of benefits used in the economic analysis
The summary benefit measure used was the rate of correct diagnosis of the presence or absence of a retained foreign body prior to direct endoscopy (gold standard). This rate was estimated using the decision models. No discounting was necessary.

Direct costs
The cost analysis was restricted to the direct medical costs associated with hospital procedures and professional fees. Specifically, the cost categories included in the analysis were plain film, CT without contrast, endoscopy (with or without foreign body removal), complication (the cost of mediastinoscopy was used as a proxy) and death. The costs of operative procedures included the surgeon's reimbursement, the anaesthesia reimbursement and the hospital charge. The unit costs and the quantities of resources used were not presented separately, although the unit cost of the diagnostic procedures was given. The costs were estimated using average Medicare reimbursement rates as a surrogate marker for costs. The cost of death was based on estimates from the National Safety Council (death from unintentional injuries). The source of resource use was not explicitly stated, although it seems to have been derived on Medicare resource consumption and authors' assumptions. Discounting was not relevant as short-term costs were evaluated. The price year was 2006.

Statistical analysis of costs
The costs and the quantities were treated deterministically.

Indirect Costs
Productivity costs were not included.

Currency
US dollars ($).

Sensitivity analysis
A deterministic sensitivity analysis was carried out by varying all cost data and prevalence variables in a one-way analysis. Alternative ranges of values were derived from the literature (clinical data) or set by the authors (cost estimates). A two-way sensitivity analysis was undertaken by simultaneously varying the sensitivity of CT along with the cost of complications. Threshold analyses were also performed.

Estimated benefits used in the economic analysis
In the single-modality model, the rate of correct diagnoses was 0.919 with CT alone, 0.827 with XR alone and 1.0 with NHS Economic Evaluation Database (NHS EED) Produced by the Centre for Reviews and Dissemination Copyright © 2017 University of York
endoscopy alone.

In the sequential model, the rate of correct diagnoses with XR followed by CT was 0.847.

Cost results
In the single-modality model, the total costs per patient were $531.80 with CT alone, $751.80 with XR alone, and $957.40 with endoscopy alone.

In the sequential model, the total costs per patient with XR followed by CT if negative were $589.90.

Synthesis of costs and benefits
An incremental analysis was performed to combine the costs and benefits of the alternative strategies. In the single-modality model, where CT was the reference strategy, XR alone was dominated by CT alone (both more effective and less expensive) and the incremental cost per correct diagnosis with endoscopy alone was $5,238.

Similar results were obtained in the sequential model: where CT was the reference strategy, XR followed by CT was dominated by CT alone and the incremental cost per correct diagnosis with endoscopy alone was again $5,238.

The results of the sensitivity analysis showed that CT alone remained the preferred strategy unless the cost of death dropped below $310,971 ($1,130,000 in the base-case analysis), the risk of death from an undiagnosed foreign body dropped below 8 in 10,000 (0.32% in the base-case), or the prevalence of foreign bodies overall dropped below 8.8% (14.66% in the base-case). Under these conditions, XR became the preferred strategy. In the sequential model, CT remained the preferred strategy in almost all plausible scenarios. Similar results were observed in the two-way sensitivity analysis.

Authors’ conclusions
Computed tomography (CT) was a cost-effective strategy for the diagnosis of ingested foreign bodies in adult patients. In settings where CT is not available, direct endoscopy may represent the preferred strategy over plain radiography (XR) although it adds significant costs from the perspective of the health care system.

CRD COMMENTARY - Selection of comparators
The authors stated that XR is the standard approach to the diagnosis of ingested foreign bodies. However, owing to its unreliability, CT and direct endoscopy have been proposed as alternative diagnostic strategies. Endoscopy was considered to be the ‘gold’ standard. Thus, the choice of the comparators appears to have been appropriate. The authors justified the exclusion of contrast esophagography as an alternative diagnostic approach. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The clinical data were estimated from a review of the literature, the methods and conduct of which were described. A large number of patients from each study were involved. However, the authors did not report what types of studies were included in the review, which excluded only case reports. Therefore, it is not possible to evaluate the validity of the clinical estimates as their sources were unclear. The authors noted the lack of prospective studies on the diagnostic approaches, which suggest that mainly retrospective studies were used. Weighted averages were calculated in order to combine the clinical inputs. The authors acknowledged the uncertainty surrounding some clinical data, which were varied in the sensitivity analysis. Another potential weakness of the study was the heterogeneous nature of the primary studies.

Validity of estimate of measure of benefit
The summary benefit measure was specific to the interventions under examination and, although quite common in diagnostic studies, it is difficult to compare with the benefits of other health care interventions. Furthermore, it is difficult to attribute an economic value to a case diagnosed.
Validity of estimate of costs
The strict inclusion of direct hospital costs and the use of Medicare sources suggests that the cost/resource boundary of the reimbursement authority was adopted. Adequate information on the estimation of the costs was provided, but few details on resource use were reported. Medicare codes were used for both hospital services and professional fees. Thus, the costing analysis reflected the US setting and may not be easily transferable to other health care systems. Statistical analyses of the costs were not performed but all cost estimates were varied in the sensitivity analysis. The authors reported the price year, thus facilitating reflation exercises in other time periods.

Other issues
The authors did not make extensive comparisons of their findings with those from other studies. They also did not explicitly address the issue of the generalisability of the study results to other settings. However, the use of sensitivity analyses enhances, to some extent, the external validity of the analysis. Both the results of the base-case analysis and the sensitivity analyses were satisfactorily reported. It should be noticed that the results of the analysis changed dramatically when the cost of death was reduced (XR then became the best option, rather than being dominated). Since the inclusion of a cost for death is still a debatable issue in economic evaluations, this appears to be a key assumption of this analysis.

Implications of the study
The results of the analysis suggest that CT might represent a cost-effective approach to the diagnosis of ingested foreign bodies. The authors stated that prospective studies should be carried out to validate the current findings.

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