The appropriate use of neuroimaging in the diagnostic work-up of dementia: an economic literature review and cost-effectiveness analysis

Bermingham SL

Record Status
This is an economic evaluation that meets the criteria for inclusion on NHS EED.

CRD summary
This study aimed to evaluate the cost-utility of clinical prediction rules, with structural imaging by computed tomography (CT) or magnetic resonance imaging (MRI), for the diagnosis of dementia. The authors concluded that the uncertainty in the diagnostic accuracy estimates meant that the most cost-effective strategy could not be defined. The study methods appear to have been appropriate, and the study was reasonably well reported. The authors’ conclusions are appropriate.

Type of economic evaluation
Cost-utility analysis

Study objective
This study aimed to evaluate the cost-utility of clinical prediction rules, with structural imaging by computed tomography (CT) or magnetic resonance imaging (MRI), for the diagnosis of dementia.

Interventions
Four neuroimaging strategies were compared. In all strategies, the patients were clinically assessed.

In strategy one, all patients received CT, with MRI for patients who had a space-occupying lesion. In strategy two, all patients received MRI. In strategy three, depending on the Canadian Consensus Conference on the Diagnosis and Treatment of Dementia (CCC) prediction rules, patients received CT, with MRI for patients who had a space-occupying lesion. In strategy four, depending on the CCC prediction rules, all patients received MRI.

All patients who were diagnosed with Alzheimer's disease, or mixed Alzheimer's disease and vascular dementia, were assumed to receive acetylcholinesterase inhibitors. Patients with vascular dementia were assumed to receive aspirin.

Location/setting
Canada/secondary care.

Methods
Analytical approach:
A decision tree was developed to determine the positive and negative predictive values of disease. Markov models were then used to determine the costs and utilities of the natural history of dementia with different causes. All models were probabilistic. The causes were Alzheimer's disease, vascular dementia, normal-pressure hydrocephalus, subdural haematoma, and brain tumour. The time horizon was lifetime. The authors stated that the perspective was that of the Ontario Ministry of Health and Long-Term Care.

Effectiveness data:
The clinical data included disease prevalence, the sensitivity and specificity of the tests, disease progression probabilities, and the absolute and treatment relative risks of outcomes, such as stroke or death. The transition probabilities were from a published model that used data from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD; see Other Publications of Related Interest). The diagnostic accuracy of the CCC rules came from a primary diagnostic study, which had CT as the gold standard. Prevalence was estimated based on a published meta-analysis and a Canadian cohort study. Diagnostic utility was estimated based on a clinical evidence-based analysis, conducted by Health Quality Ontario.
Monetary benefit and utility valuations:
Disease progression and the treatment effect were modelled in terms of their impact on cognitive function and rates of admission to an institution. The utilities for the six health states, representing severity of illness (mild, moderate or severe) and institutional status (community or nursing home) were modified from the CERAD publication to create three states for severity of illness. These scores were weighted by the proportion of patients in an institution, from another publication. The utilities were derived using the Health Utilities Index 2. The disutility for a stroke was applied in the vascular and mixed dementia models.

Measure of benefit:
The summary measure of benefit was quality-adjusted life-years (QALYs), which were discounted at a rate of 5% annually.

Cost data:
The costs included the drugs, imaging, procedures and care for dementia of various causes. The drug costs were from Ontario Drug Benefit data, and included donepezil and aspirin. The imaging costs were from the Ontario Case Costing Initiative. The costs of procedures and care for dementia of each cause were from a variety of published sources, including the Ontario Case Costing Initiative. All costs were reported in 2012 Canadian dollars (CAD), inflated where necessary. They were discounted at a rate of 5% per year.

Analysis of uncertainty:
Univariate, multivariate, and probabilistic sensitivity analyses were undertaken to assess the effects of uncertainty on the results. The probabilistic sensitivity analyses varied all model parameters simultaneously.

Results
Imaging all patients with MRI correctly identified the most space-occupying lesions and vascular dementia. There were far more patients with Alzheimer's disease than there were with a space-occupying lesion. Using CCC rules for CT followed by MRI had the greatest combined specificity to rule out space-occupying lesion. This strategy was dominant as it produced the most QALYs at the least cost.

If MRI had a specificity of 64% for detecting vascular dementia, the most cost-effective strategy was CCC rules for MRI. At a specificity of 85%, imaging all patients with MRI was most effective, but had an incremental cost-effectiveness ratio of more than CAD two million. Most of the sensitivity analyses did not alter the conclusions. In one analysis, it was assumed that only half instead of all patients who were not eligible for imaging received acetylcholinesterase inhibitors; CT imaging for all patients was dominant.

Authors' conclusions
The authors concluded that the uncertainty in the diagnostic accuracy estimates meant that the most cost-effective strategy could not be defined.

CRD commentary
Interventions:
The interventions were described. The diagnostic methods used in the study setting were appropriately included. The authors explained their exclusion of an alternative diagnostic guideline, due to the absence of comparative evidence.

Effectiveness/benefits:
The prevalence and diagnostic information appear to have come from a study conducted by Health Quality Ontario, and so the data are likely to be relevant to the Ontario setting, but the evidence-based analysis was not described, only the reference was given. The source for the utility data was reported, but the details of the utility estimates were not. The health outcomes were comprehensively modelled in several models of the natural history of dementia of different causes.

Costs:
Those costs relevant to the study perspective appear to have been analysed. Few details of the costs were given, as there were many estimates, but their sources were reported. Most of the details of the cost adjustments were reported, but not the index used to inflate the costs.
Analysis and results:
The model structure and analytic methods were well reported. The results were well reported. Uncertainty in the results was assessed, but the probability distributions for the model parameters were not reported. The authors discussed the limitations of their modelling.

Concluding remarks:
The study methods appear to have been appropriate, and the study was reasonably well reported. The authors' conclusions are appropriate.

Funding
Funded by Health Quality Ontario, Canada.

Bibliographic details
Bermingham SL. The appropriate use of neuroimaging in the diagnostic work-up of dementia: an economic literature review and cost-effectiveness analysis. Toronto, ON, Canada: Health Quality Ontario. Ontario Health Technology Assessment Series; 14(2). 2014

PubMedID
24592297

Original Paper URL

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Brain Neoplasms /diagnosis /economics /epidemiology; Cost-Benefit Analysis; Decision Support Techniques; Dementia /diagnosis /economics /epidemiology /therapy; Evidence-Based Practice; Health Care Costs /statistics & numerical data; Humans; Magnetic Resonance Imaging /economics; Markov Chains; Neuroimaging /economics /standards; Ontario; Practice Guidelines as Topic; Predictive Value of Tests; Quality-Adjusted Life Years; Sensitivity and Specificity; Seveso Accidental Release; Stroke /economics /epidemiology; Tomography, X-Ray Computed /economics

AccessionNumber
22014012295

Date bibliographic record published
31/03/2014

Date abstract record published
23/06/2014